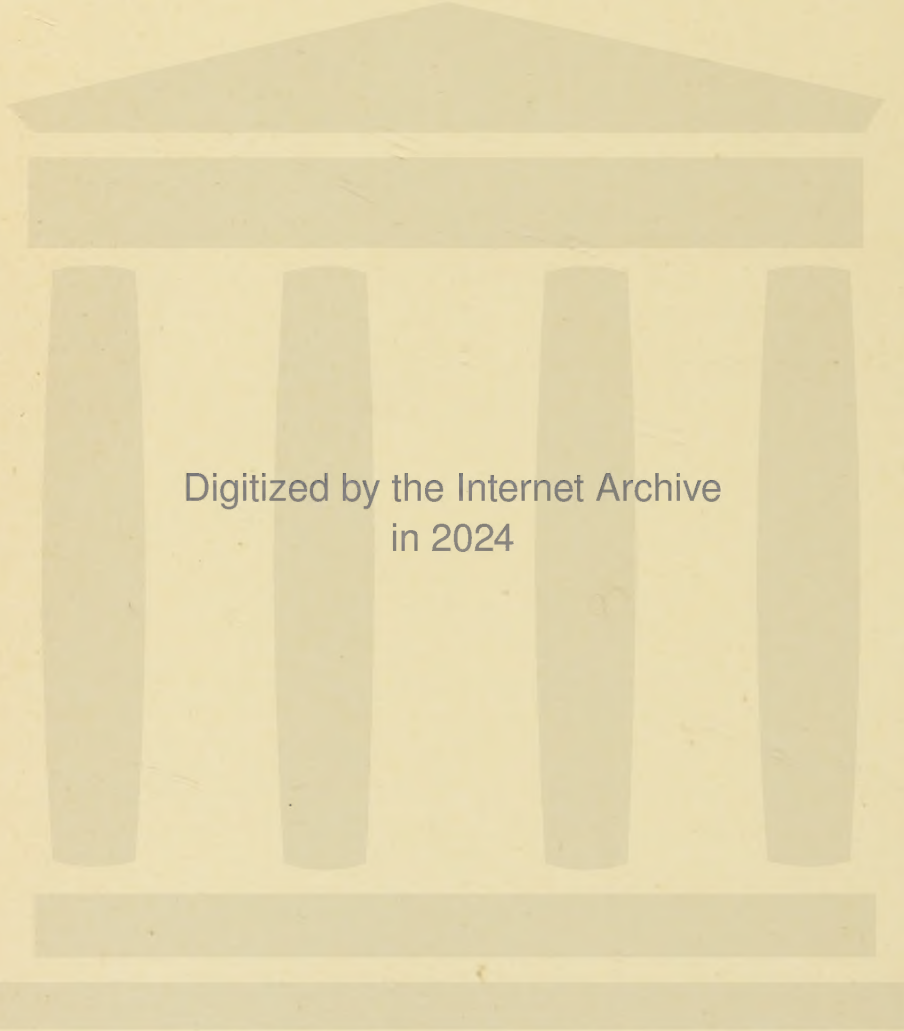


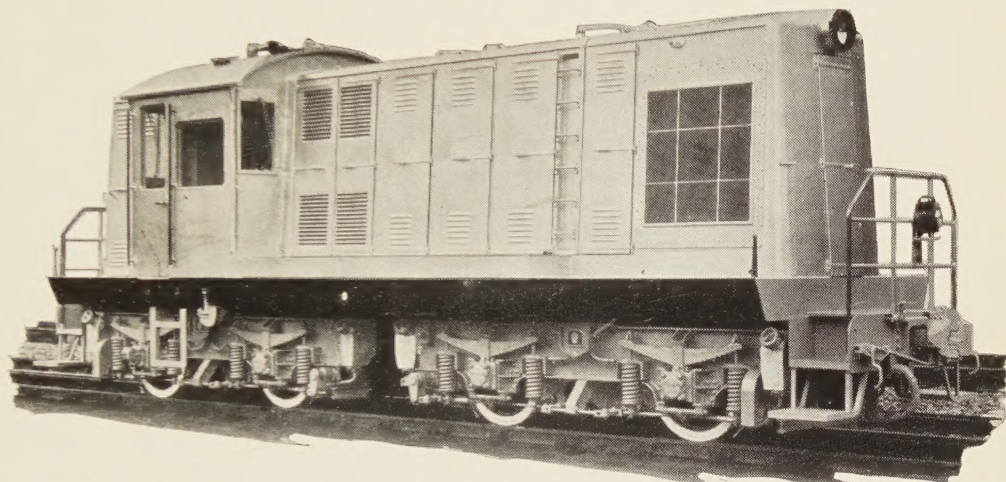
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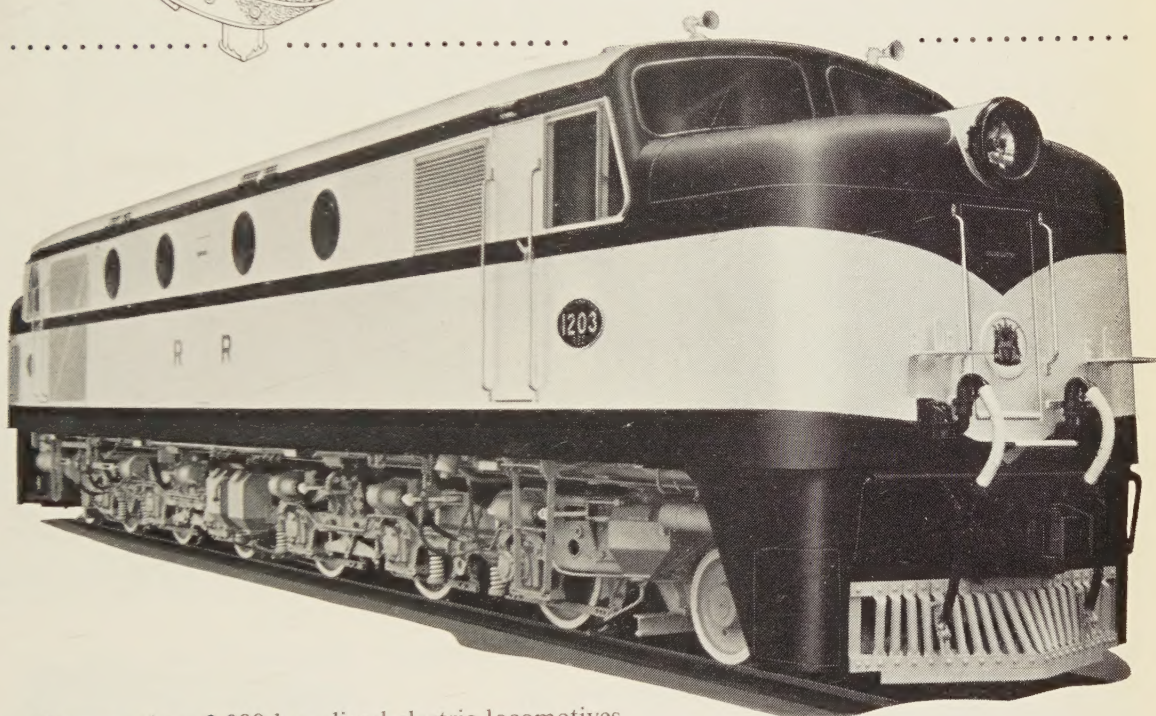
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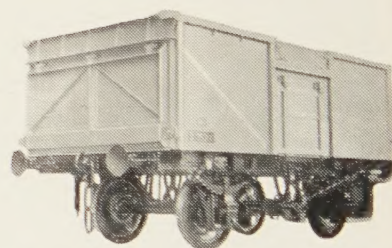
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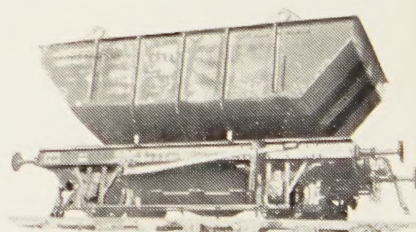
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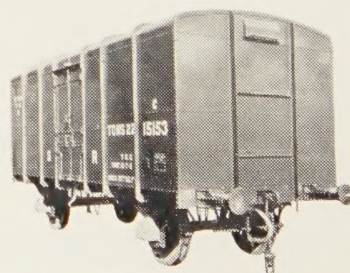
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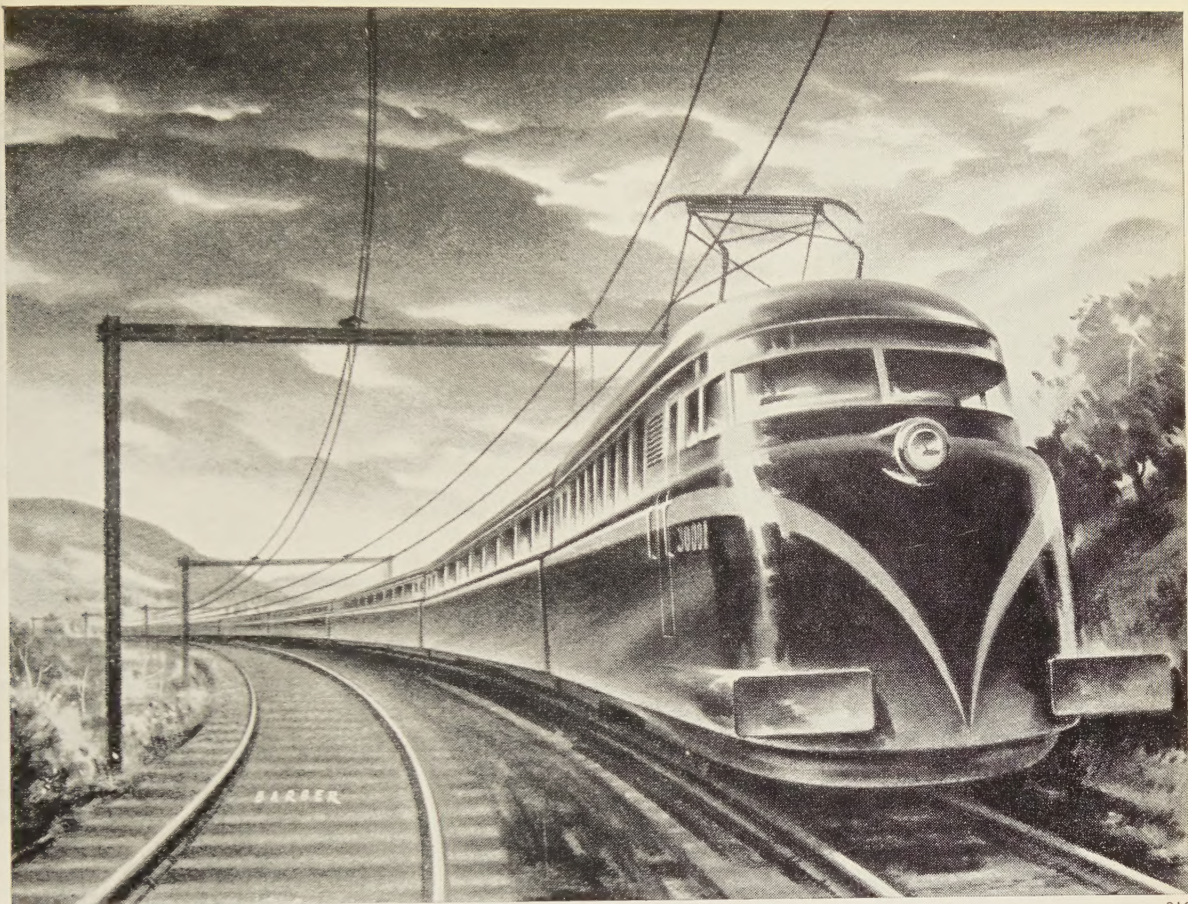
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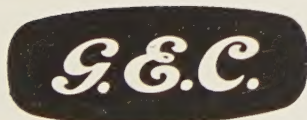


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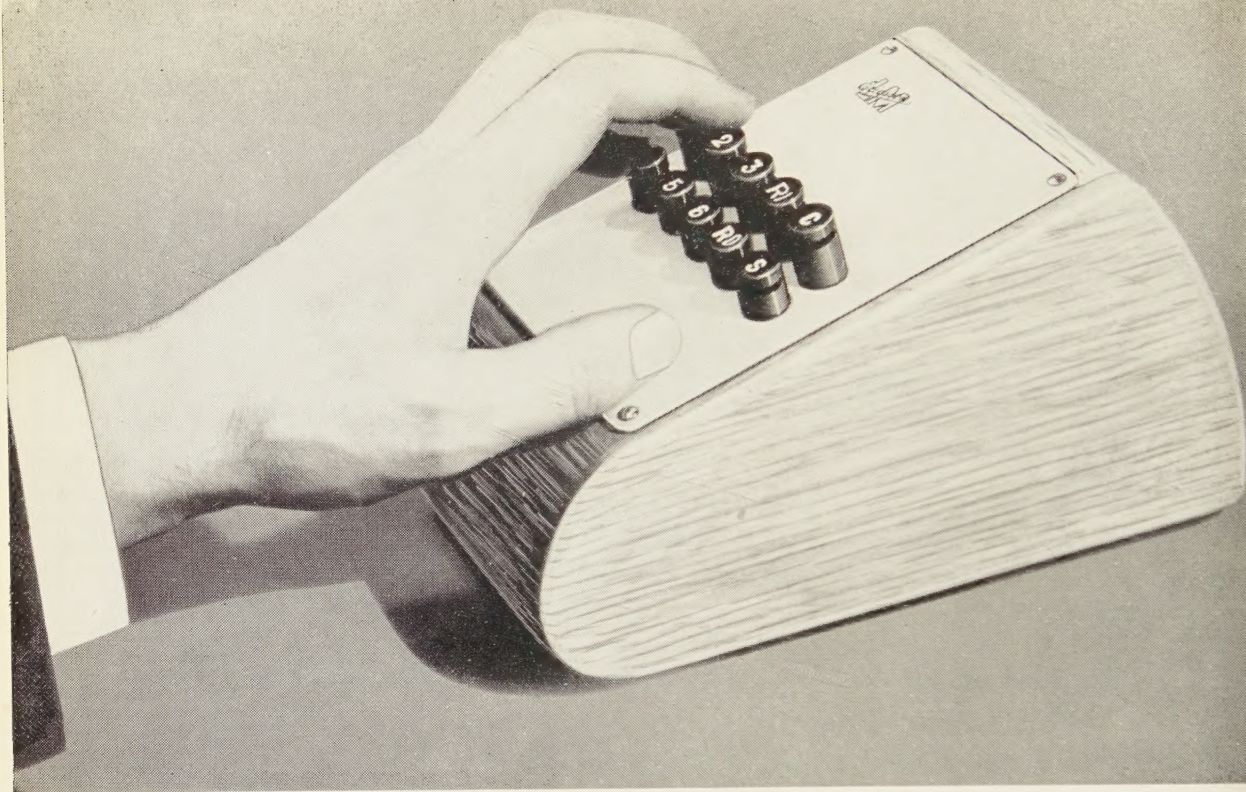
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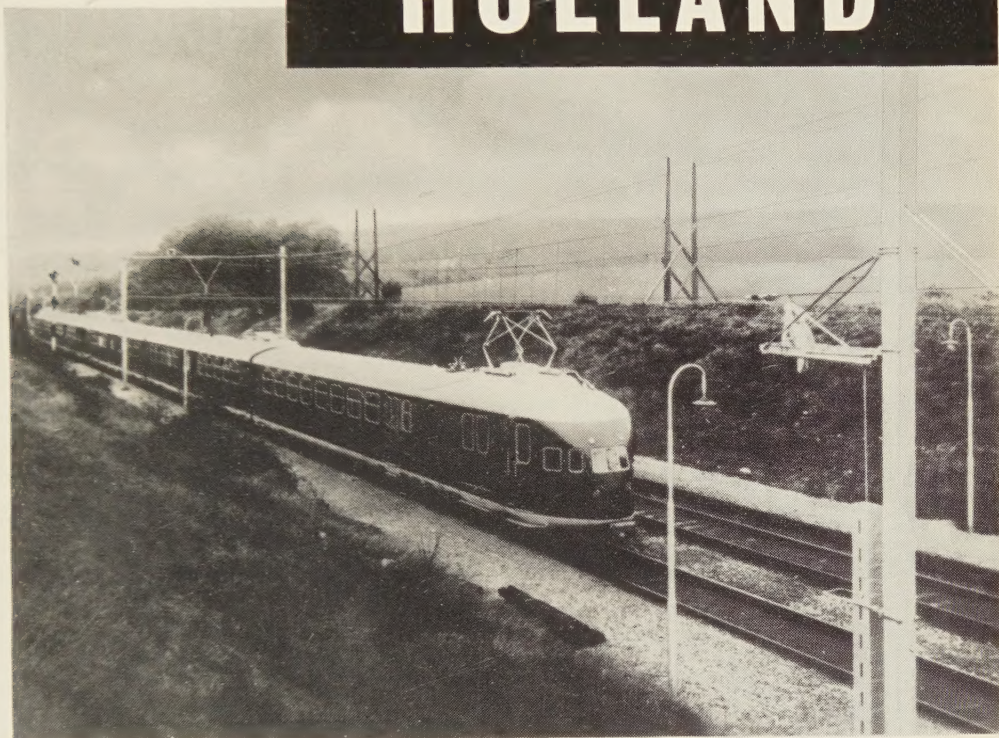
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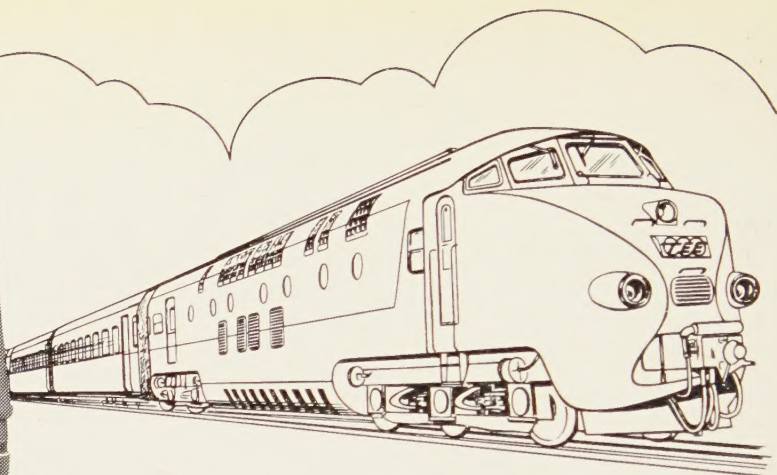
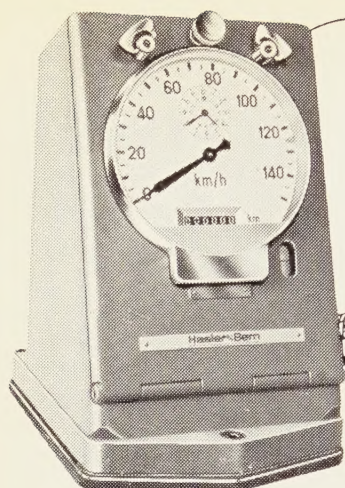
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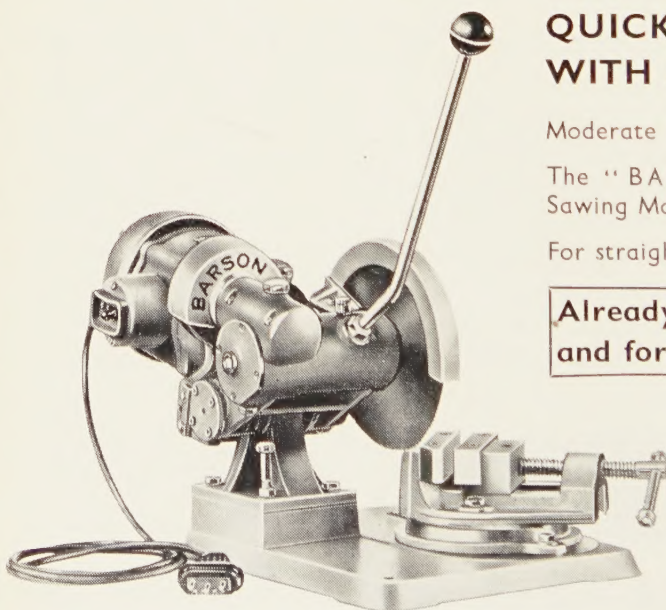


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MONTHLY BULLETIN

OF THE

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BULLETIN
OF THE
INTERNATIONAL RAILWAY CONGRESS
ASSOCIATION
(ENGLISH EDITION)

[625 .6 (45)]

Reorganisation of the concessionary Railways in Italy,

by Prof. Dr. Ing. Ernesto STAGNI.

1. GENERAL PROBLEMS

Apart from the State Railways, which are 17 083 km long, there is a secondary railway system in Italy of concessionary lines, operated by private companies, which at the end of 1952, the date when the measures reported in this present note first began to be applied, amounted to 6 833 km, 1 480 km of which could be classified as suburban tramways.

Two important groups can be distinguished in this system: the light railways with heavy passenger traffic from Milan (North of Milan Railway, 338.5 km) and Naples (Circumvesuvian Railways, 132.8 km, 0.95 m gauge), both electrified, with sufficiently up-to-date installations and stock and in a fairly flourishing economic position. Then, there are several suburban tramway systems (for example, the « Tramvie dei Castelli », at Rome, the Intercommunal Tramways of Milan and Naples), which may be considered as an extension of the urban services and which should be reorganised by suitable measures covering these cities.

All the rest of the lines, with a few rare exceptions, are in a very difficult situation from the technical and financial points of view, and require direct assistance from the State.

The absence of any renewal works during and after the war has led to a practically general technical deterioration of the installations and stock. Keeping steam traction, even for the light services, the absence of mechanised installations for signalling and shunting, the weakness and age of the permanent way, incapable of supporting any increase in the axle loads or speeds, have on the one hand a very unfavourable influence on the type of employee, and on the other on the efficiency of the service compared with the ever increasing demands of the public. To these difficulties must be added the heterogeneous nature of the lines, and the way they are divided up into small portions without any apparent reason between different companies, the result of their history and concession rather than any logical grouping of the system, which involves a dispersion of the operating directives and general services, and

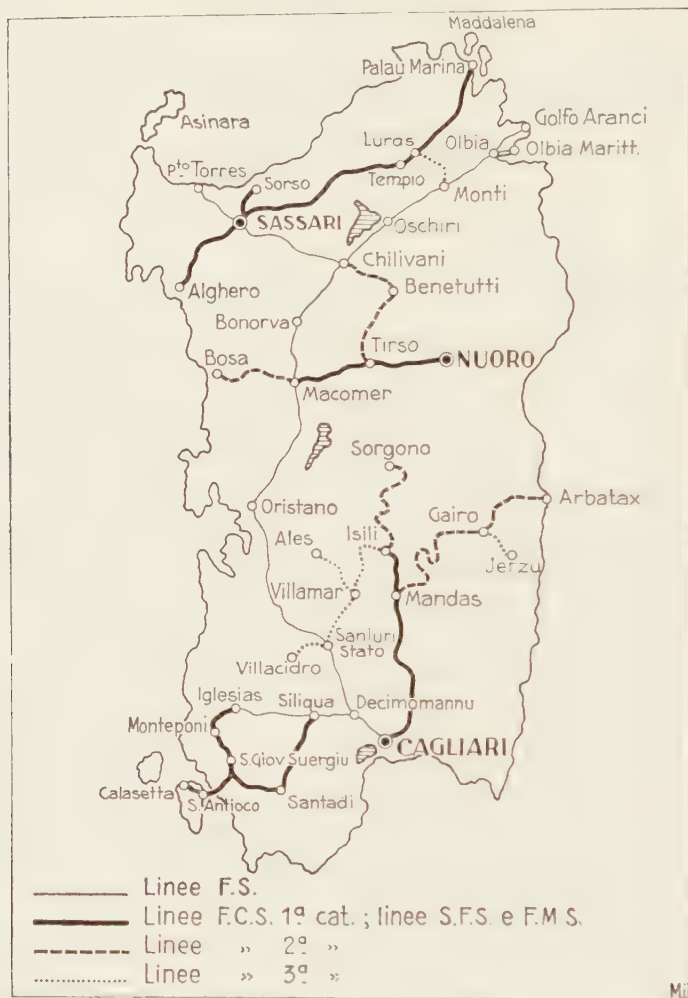


Fig. 1. — Sardinia railway lines. The F.S. lines are standard gauge; the other lines are narrow gauge (0.95 m). The 1st category lines (full lines) will be modernised; the 2nd category lines (broken lines) will be retained temporarily; the 3rd category lines (dotted lines) are replaced by motor road services.

result finally in increasing the difficulties and costs.

It will be noted that besides the three important relatively coherent systems (« Ferrovie del Sud-Est », standard

gauge, 473.5 km; « Ferrovie della Sardegna », 0.95 m gauge, 835.3 km; « Ferrovie Calabro-Lucane », 0.95 m gauge, 737.2 km), and other small groups of a local character, there are systems like the

« Soc. Veneta » (432.6 km) consisting partly of electric tramways and partly of steam lines, both standard and narrow gauge, and as a result not linked up together and situated in different regions (there are at least six undertakings: Un-

tion) and other small undertakings irregularly scattered throughout the country.

THE REORGANISATION LAW

All the above causes led, in the great majority of cases, to ever increasing loss



Fig. 2. — « Ferrovie del Sud-Est » (473.5 km). All the lines will be retained and modernised.

dine, Mestre, Padua, Ferrara, Bologna and Parma); like those of the « Ferrotramvie Veronesi » (104.7 km part railway, part tramway with electric trac-

tion) and other small undertakings irregularly scattered throughout the country. The freight traffic has fallen off considerably and continues to decline, especially on the narrow gauge lines. The passenger traffic

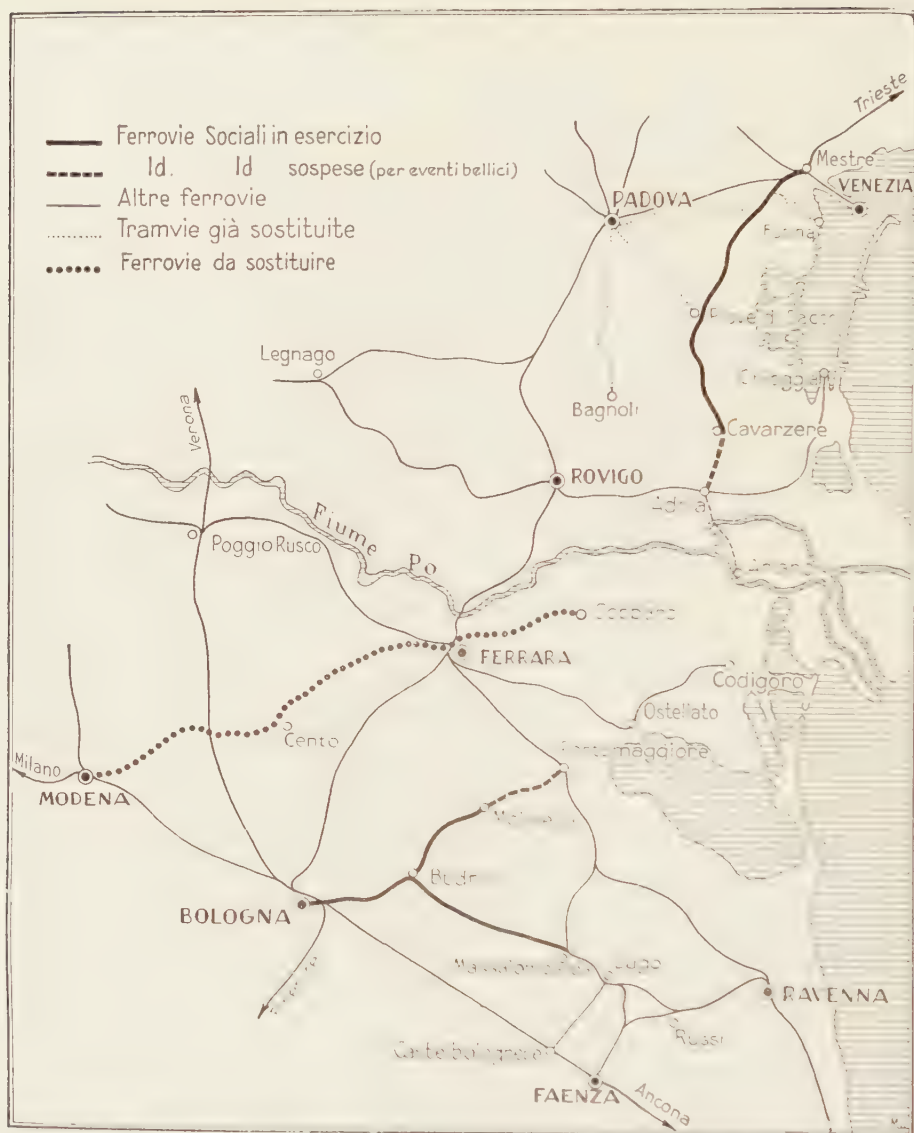


Fig. 3. — Veneto-Romagnolo group of the « Società Veneta » (304,3 km). Full lines show the network to be modernised; the sections of broken lines (damaged sections during the war) will be reconstructed, except the Adria-Ariano section. Dotted lines show the sections replaced by road services.

remains at a satisfactory level, but the abundance of methods of transport all competing against each other (regular

motor services set up on parallel routes in the post-war period which the Administration has great difficulty in can-

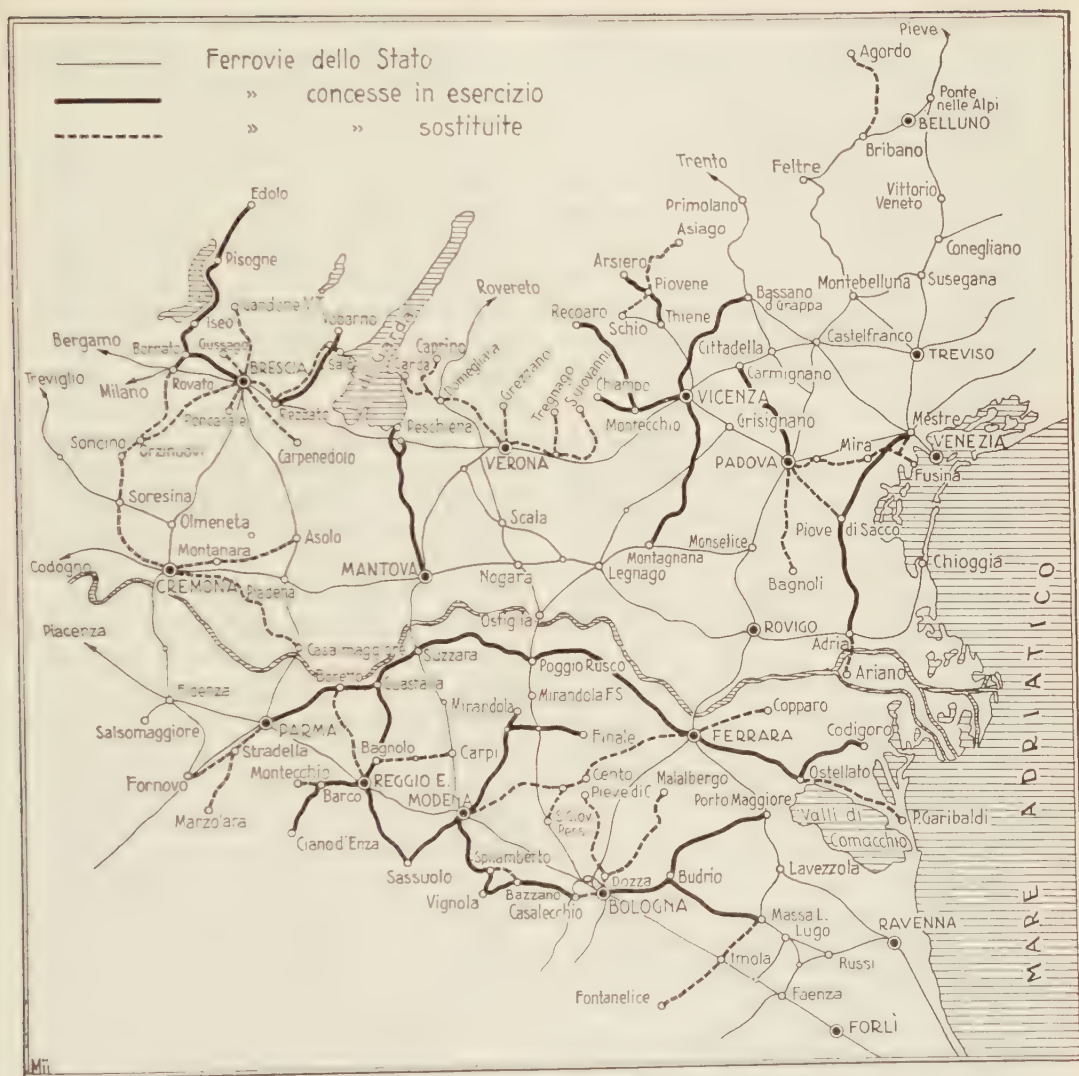


Fig. 4. — Concessionary railways in operation and replaced by road services in the lower Po valley.

celling, motor vehicles for hire, and finally, even more than private motorcars, light motorcycles which have developed to a surprising extent in Italy)

results in the essential traffic being the least profitable (workmen, students and employees travelling at special [social] rates at the very low level of 1 to 3 liras

per passenger-km) and prevents any attempts to raise the rates from a fear of new losses of traffic at the standard rate.

To make the situation a healthier one, it was laid down by a law passed by the Italian Parliament (Law of the 2nd August 1952, No. 1221, known as the « reorganisation law ») that a technical and financial reorganisation programme should be introduced for these lines, a plan which lays down three alternative solutions, listed in the first article of the law, viz. :

- a) lines which whilst not showing an operating profit, are in a satisfactory technical situation, as regards both installations and rolling stock, which consequently are able to solve their technical problems by the normal annual renewals;
- b) lines whose system of traction it is absolutely essential to alter, or in general undertake alterations to the fixed installations and improvements to the rolling stock;
- c) lines which it would be more expedient to replace by road services (buses or trolley buses).

The law lays down two different forms of financial intervention :

- an annual operating subsidy (up to a limit of 600 000 Lire per km for lines in the Centre and North of the country, and 1 400 000 Lire per km for lines in the South and the islands) for the three cases a), b) and c) above;
- for b-lines alone, a contribution once for all towards the work of trans-

forming and improving (up to 50 % of the amount involved for lines in the Centre and North, 75 % for lines in the South).

It is obvious that the law, although favouring the southern part of Italy whose economic development is less advanced, has as its first and principal object to make a discrimination between those railways which are worthy of survival and those which can be replaced by road services to the greater advantage of the community. The State Administration (Ispettorato dei Trasporti in concessione — Inspection of Concessionary Transport), through the Interministerial Commission specially set up by the law, has considerable powers in this connection for deciding, even against the wishes of the concession-holder, which of the three solutions a), b) or c) above shall apply: the only limitation is that it is impossible to suppress a line without replacing it by a special road service, or to increase the annual operating subsidy above the figures given above; should either of these two cases arise, it is necessary to refer the matter to Parliament for legal action to be taken.

It is clear moreover that this need for discrimination corresponds to a deeply rooted conviction, not expressly formulated by the law, that a great part of the secondary lines with little traffic are with their present structure and organisation economically out of date and destined to suffer a low and invincible decline, and in order to avoid such a decline it is better to make an opportune and courageous decision to replace them by road services in all possible cases.

However, the law after having affirmed

the necessity for discrimination, seems to have remembered that the replacement of a railway line by a regular road service is in fact an *increased advantage* for the community, i.e. not only does it *cost less*, but it is of greater or at the least equal *usefulness*. More precisely, the law explicitly gives two conditions in this connection: one concerning the users, i.e. laying down in case c) that the new road service shall offer the same rates and conditions of transport as the former railway service; the other concerning the staff employed, which makes it clear that the economic comparison between the two systems must be based on the actual wage conditions in force for railway and tramway employees (wages, social benefits, and above all working hours and regulations) even in the case of the substitute road services.

The reorganisation law, on the other hand, could not give any striking results in connection with the problem of the more rational distribution and regrouping of the lines, because such a redistribution would affect above all lines belonging to the F.S. (State Railway) and consequently involve a further special law affecting the State Railways. However, this problem remains a topical one and will be dealt with in a second stage.

2. SURVIVAL CRITERIA

An examination of the economic position of the different lines, and even their economic comparison is undoubtedly the essential basis for any decision regarding the various solutions a), b) and c) above.

The limit to the kilometric subsidy laid down by the law in clause 2 is only an

indication, but not a general criterion, since the law itself expressly states that this limit can be exceeded provided the matter is first of all referred to Parliament. If any general criterion is to be invoked to decide on the survival or suppression of a railway or tramway line, this must be an examination of the variation in the *total social cost* corresponding to suppressing the railway services and transferring all the traffic to road services ⁽¹⁾.

To meet the objectives of the law, it is however necessary to evaluate at the same time the *variation in usefulness* resulting from the transfer of the services from rail to road: a variation in usefulness which if it could be measured would be added algebraically to the variation in the social cost to obtain the balance-sheet for the changeover.

It can be affirmed that, faced with a situation in which there is full competition between railway and road, and in spite of this the railway retains a net product P, this product also represents the actual usefulness of the railway for

⁽¹⁾ By *total social cost* must be understood in this case, the sum of the total expenditures borne by the community for transport carried out on a certain route. If the traffic on this given route is transferred from one system to another (for example from the railway to the road), there will be a variation in the social cost which is given by the algebraic sum of the *cost of the change-over*, i.e. the costs which remain (positive) or are done away with (negative) owing to the transfer of the traffic in question. If the algebraic sum gives a negative total, the social cost is reduced and consequently the transfer of the traffic or replacement of the system of transport is advisable. Cf. GUZZANTI: « Atti de V Congresso dei Trasporti » (Report of the Vth Transport Congress) *Trasporti Pubblici*, June 1954.

its *direct users*. Therefore doing away with the railway would in such a case lead to a diminution of this usefulness, which at its maximum is equal to this value P.

Having said this, the theory of social costs has led us to lay down as the economic criterion the following consideration: *a railway with little traffic, even when run on ultra-economic lines, is in no way worthy of survival if its receipts P are lower than the effective cost I* (labour and materials used for maintenance, the general services and renewals), which such a railway has to meet for *its own fixed installations* (social headquarters, permanent way, buildings and other installations). It is a proven fact that in this case a substitute road service is always the better solution, even if it were *completely free* for its users.

This criterion — which has been applied, it goes without saying, as a guidance — may appear at first sight unduly simplified and frankly brutal, but it appears to be sufficiently well founded if the following conditions or hypotheses are met:

- a) the survival of the railway makes it essential, for safety reasons or in any case necessary if operating is to continue, to replace the permanent way or undertake other costly work to the installations (for example the construction of an independent road-bed for suburban tramways);
- b) that the roads adjoining the railway can carry the road services replacing the railway services without costly renewal work or improvements; that in every case the increase in the road

maintenance costs S corresponding to this new traffic shall be made up by the value R corresponding to the recovery of the installations and fixed stock from the demolition of the railway (2);

- c) that it is essentially a case of passenger traffic, or in any case that the freight traffic in full loads shared with the State Railways is not great (3);
- d) that the total cost of operating the replacement road services does not differ much, or at least does not

(2) This condition is sufficiently verified when we consider the *average* cost of the maintenance of the road on the whole Italian system. In effect, taking into account the materials used and various installations, (for the non-electrified lines), the material recovered would exceed a figure of 2 million Lire per km, which at the rate of 5 % gives an annual interest of 100 000 Lire per km. On the basis of the distribution per tonne-kilometre and per vehicle-kilometre of the total maintenance costs (Cf. GUZZANTI: *Trasporti terrestri di viaggiatori* — Overland passenger transport — Vth Transport Congress), a large omnibus has an average cost of Lire it. 11.00 per km; this sum therefore corresponds to 12 daily services in each direction.

Naturally, the position is quite different if the replacement traffic involves special work in repairing or making roads; for example the simple tarring of a 6 m wide road already involves a minimum cost of 4 million Italian lire per km, the annual interest on which must be added to the above maintenance costs in order to determine the cost of the change over.

(3) In effect, long distance freight traffic comes to an end in practice if the connection with the railway is less favourable or when it is a question of goods (for example agricultural produce) for which rail transport is preferred. The question of keeping a line open for freight traffic alone was also gone into, making it merely a railway side-line.

exceed the traction and service costs T for the railway traffic, including the proportion corresponding to the general and diverse costs and the financial charges or rolling stock replacement costs ⁽⁴⁾.

In the above conditions, the economics of the social costs in the change over from rail to road are given by the cost I , i.e. the expenditure the railway has to make in any case to maintain the installations needed for its traffic.

In effect, the cost of the change-over (negative) when suppressing the railway will be $I + T + R$, and the corresponding cost (positive) for carrying out the replacement services is $A + S$; the total

cost of the change-over, in other words the variation in the social cost is therefore $A + S - (I + T + R)$ which, if A and T cancel each other out, as also R and S , is reduced to a single term $-I$.

If it is admitted that the traffic product P represents the direct usefulness of the transport and $P \leq I$, the social balance sheet remains favourable, even in the extreme and impossible case in which the replacement of the service would completely cancel out this utility (which would make it necessary to offer the service in question gratuitously).

Naturally, our criterion has to be amended as the above average conditions are departed from.

The non-realisation of condition *a*) would turn the scales still more in favour of the change-over; however, it is easy in this case to correct the equation of comparison by adding to the operating costs I the annual financial charges I_f corresponding to the cost of work on the permanent way or other similar work. The amount to be added is of particular importance in the case of tramways running on the public roads which for safety reasons in conjunction with the road traffic must necessarily be transferred to independent road-beds.

On the contrary the non-realisation of conditions *b*) and *c*) favour the retention of the railway. The need for new road-works owing to the insufficiency of the present network brings in a similar financial term I_r which in the equation of comparison acts in the opposite way to the term I_f above. However, the lack of liaison between the road and railway programmes does not make it pos-

(4) This condition is achieved fairly accurately when the railway is operated by light types of diesel railcars. In fact, the cost per seat-kilometre on an up-to-date large capacity railcar (55 seats) is about 3 It. Lire all in; on a three-axle articulated motor coach (92 seats) it is about 2.3 It. Lire (Cf. ARMANI: «Entità e costo degli autotrasporti» — Value and cost of motor transport — *Trasporti Pubblici*, January 1956). For a light type of railcar with 72 seats, the cost per seat-km for the railcar only and for the traction costs only (fuel consumption, repairs, driving staff, sinking fund) and the train staff amounts to 2.7 It. Lire; adding the other staff costs (traffic and shunting, about 50 % of the train staff) plus a proportion of the general costs amounting to 6 %, we get 3.10 It. Lire (excluding only the maintenance of the line, the general services, the installations and buildings). For the same railcar with trailer, the corresponding figures are respectively 1.97 and 2.25 It. Lire (Cf. MELANI: *Bollettino Informazioni F.S.*, No. 4, 1955; CAMPOSANO, *Ingegneria Ferroviaria*, No. 7-8, 1956; STAGNI, CAMPOSANO and MELANI, *Politica dei Trasporti*, No. 7-8, 1954).

The case of electric traction makes no appreciable difference to the above comparison as far as light traffic is concerned.

Note. — 100 It. Lire = about 0.70 Swiss fr.; 8 Belgian fr.; 67 French fr.; 0.68 DM.

sible to evaluate (except in extremely rare cases) what part of this cost I_r is to be attributed to the replacement traffic and what part to the ordinary traffic.

In its turn, the transfer to the road of the freight traffic in complete loads is common with the State Railway services, especially in the case of long distance traffic, even if it is not a question of irreplaceable transport, will always lead to increased costs for road transport, which will not be compensated by the insignificant reduction in the overall operating costs on the F.S. system or by greater usefulness.

Apart from these motives, which must also be considered as of an economic nature, although under the wider aspect of the social cost, other reasons must also be taken into account, which are incorrectly called social, but which it is impossible to evaluate quantitatively, though they preoccupy the legislator and affect the *indirect utilisation*. For example, additional traffic may be expected in the future, especially freight traffic, due to a general improvement in the productivity of the region serviced, or to transport facilities under exceptional circumstances (military transport, connections with the State Railways) which encourage the conservation of certain railway lines no matter what may be their present traffic, which, when they occur, make it necessary to give special attention to the position. But apart from such infrequent cases, which the Administration has always taken into account in a realistic fashion, in really important cases (Sardinia and the South-East), there is no reason of any kind whatsoever which justifies the survival of

a line according to the criterion we have given.

It should be noted, in addition, that if this criterion is reached, under the average conditions given above, it can be affirmed as *practically certain* that it is opportune to make the change-over, which does not prevent there being other cases in which, although the criterion of survival is not reached, this advisability may appear probable. It will be seen however that, particularly in doubtful cases, the Administration has been very prudent in coming to a decision, so as to meet fully the intentions of the legislator in every case.

Confirmation of what we have just said will be found in Tables I and II.

Table I gives figures for some of the more important lines replaced by motor services; it will be noted that for some of these, the financial costs I_f which would have been essential to replace the permanent way or transfer it to an independent road-bed (case of suburban tramways) played the decisive part.

The other lines, not given in the list (in all 1 360 km of lines have been replaced) were also, with very rare exceptions, below the survival limits.

Table II, on the other hand, gives figures for the lines which were retained although reaching the limit of survival conditions.

It is interesting to see that amongst these lines, which were the *most doubtful* amongst those retained, only the Sardinia system (and in particular the group II of lines) is below the discrimination criterion given above, but in fact

TABLE I. — Data for certain lines replaced by road services.

Line or section	km	P	$I + I_f = I_{tot}$	Remarks (work necessary if line is to be kept)
		(millions of Lire per km)		
Rovato-Cremona (SNFT)	65.0	0.64	1.21	Partial replacement of the permanent way and transfer of tramway sections to a separate road bed.
Ferrottramvie Veronesi	104.7	1.92	$1.20 + 1.14 = 2.34$	
Modena-Ferrare-Copparo (Società Veneta)	83.8	1.80	$1.20 + 0.62 = 1.82$	
Padua Tramways (Società Veneta)	96.6	3.08	$1.20 + 2.14 = 3.34$	Partial replacement and transfer to separate road bed.
Reggio-Boretto and Bagnolo-Carpi. (Ferrovie Reggiane)	45.9	0.62	1.09	Replacement of permanent way.
Ferr. Fermana	59.7	0.69	$0.74 + 0.70 = 1.44$	
Syracuse-Ragusa-Vizzini . . (Sicily Secondary Rys.)	126.2	0.14	0.60	
Isili-Villacidro, and Villamar-Ales (Sardinia Rys. - 3rd group)	90.2	0.11	0.94	

P = annual product per km.

I = cost of maintaining track and installations.

I_f = financial charge for work to the track and installations essential if the railway is to be retained.

Lines already replaced from 1952 to 1956 : 1 360 km.

Lines for which the substitution is expected in the near future : 568 km.

the Administration considered that no criterion nor theory made it possible even to think of giving them up completely. However, even in this network of lines, a *first group* can be clearly seen for which the product P is at least higher than the actual maintenance costs I, whilst a second group shows definitely lower values.

There are also valid reasons for maintaining the lines of the first group,

amongst them some corresponding to the economic-social motives expressed above; in the first place hopes of an increase in productivity throughout the region, owing to the considerable amount of capital that has been invested in agricultural works, and secondly the obvious insufficiency and at times total lack of adjacent roads for the effective working of replacement services.

These reasons are much less valid in

TABLE II. — Data relating to the railways which will be retained though they are close to the economic limits.

Line or section	km	P	$I + I_f = I_{tot}$	Remarks.
		(millions of Lire per km)		
Parma-Suzzara-Ferrare . . .	125.0	1.79	$1.15 + 0.24 = 1.39$	Important connections with State Rys.
Reggio Emilia-Ciano d'E. . .	29.6	1.76	$1.09 + 0.03 = 1.12$	Track and installations in good repair.
Arezzo-Sinalunga (t.e.) . . .	39.4	1.38	$1.15 + 0.10 = 1.25$	Track and installations in excellent repair, but stations far from towns.
South-East system	473.5	1.49	$1.22 + 0.18 = 1.40$	Permanent way to be replaced over 77 km. — Line and installations in good condition. — Long distance freight traffic over the whole line.
Genoa-Casella (t.e.)	24.3	1.46	$0.98 + 0.26 = 1.24$	Serves private sections of roads.
Spolete-Norcia (t.e.)	51.5	0.81	$0.71 + 0.07 = 0.78$	Parallel road in poor condition; difficult to use in winter.
<i>Sardinia System :</i>				
a) Lines of 1st group . . .	339.7	0.81	$0.74 + 0.52 = 1.26$	Permanent way to be replaced over 170 km; adjacent roads : lacking for 57 km, inadequate for 44 km.
b) Lines of 2nd group. . .	368.8	0.33	$0.74 + 0.29 = 1.03$	Roads lacking for 38 km, inadequate for 56 km.

P = Product per km.

I = Costs for maintenance of permanent way, installations and buildings.

I_f = annuities of financial charges for essential work to the track and installations.

the case of the lines coming into the second group, for which it was considered opportune to replace them by road services, even though this involved building new sections of road and the radical reconstruction of the inadequate roads

already in existence. But the Sardinian lines, especially those of the Cagliari and Macomer group, have reached such a state of deterioration, especially as far as the permanent way is concerned, that one was faced with a dilemma: either

to carry out immediately the work strictly essential for *safety of operation*, or cease operating completely.

Such a state of affairs obliged the Administration, in conformity with the opinion of the Commission and the Representatives of the Sardinian Region, to maintain *provisionally* in existence even the lines of the second group, undertaking the expenditure of 1 380 million Lire needed for urgent work which could not be put off to the road-bed and permanent way (now being carried out and well forward) in order to assure safe operating.

The other *doubtful* lines are appreciably above the survival criterion, though to varying degrees; *it is therefore not certain* that their replacement would have led to great social advantages, especially when we remember the indirect motives of usefulness which favour the retention of some of them.

3. THE PROBLEM OF THE STAFF

The decision to replace a line or group of lines by motor services involves other problems which also give rise to considerable difficulties.

Above all it must be remembered that the change over will be an economy solely and above all to the extent to which the replacement motor service saves a considerable part (50 to 60 %) of the staff previously employed on the railway.

In this connection, it is not enough merely to solve the *human* aspect of the problem, in other words the isolated case of the man who cannot be re-employed in the new service, and his family; the problem also has its *social* aspect, which is the possibility of absorbing in other

profitable activities the *whole* of the staff rendered redundant by the new service, as unless this is done the staff in question or its equivalent in numbers will continue to be a burden upon the community and the saving in the social costs will remain purely illusory. This aspect of the problem is particularly topical in certain regions of Italy, unlike perhaps in other European countries.

The Administration and undertakings in collaboration with the railway unions have solved in a satisfactory way the human aspect of the problem, in particular by putting the older employees on the retired list who on account of their age and the shortage of professional jobs would find it harder to obtain new jobs in other fields.

But the *social* aspect of the labour problem is outside the jurisdiction of the Transport Administration; it is only to be hoped that after a certain time there will be a sufficient increase in productivity in the region concerned to absorb the excess labour of the present time.

It is a fact that the problem varies from one region to another; this is one of the motives which led the Administration to act with extreme prudence, as we have already said, in the case of Sardinia.

The measures adopted led to a reduction of 2 100 employees, or 23 % of the staff employed on the reorganised lines, owing both to the replacement or alteration of the operating due to modernisation measures.

4. THE REPLACEMENT SERVICES

Critics have not been lacking of the decisions of the Interministerial Commission and the Administration, from both

points of view, but it is certain that the most lively and serious were those directed against the replacement measures.

The chief motive for such reactions lies in the barely concealed distrust of the public for privately operated motor services when they have been used to the railway. The public is indifferent to the fact that the motor service is balancing its budget whilst the railway is showing a deficit; in other words, they are not concerned with the social cost, but with the usefulness of the service, and they show very clearly that they are afraid that the motor service will not prove so useful, a problem which the legislator, not without reason, has considered as fundamental.

If it is true that the motor services sometimes give better service in urban centres, particularly when the railway is some distance away, it is nonetheless true that the average speed, the regularity of the service, particularly in difficult weather conditions (fog and snow), the capacity to deal with peak traffics, and in a general way, the strict observation of service obligations resulting from effective government control leave much to be desired when compared with the railway.

It is obvious that these defects of the motor services are due to their different nature and different regime of concession. It is easy for the administrative authority to control a railway service which is bound up with well defined obligations of a technical, administrative and trade union nature; difficult on the contrary to control motor services which have no operating regulations, nor organic staff tables, nor even fixed installa-

tions bound up with their concession, which in addition, although their average cost per unit of traffic is often lower than that of the railway, nearly always have a higher marginal cost, and consequently are ill fitted to deal with occasional peak traffic which requires additional stock that will seldom be used.

However, the replacement services introduced by the reorganisation law suffer much less from the above defects because the Administration, carrying out the intentions of the legislator, imposes preferential tariffs, convenient timetables, a definite seat capacity per km, and a standard of stock at least equal to that of the former railway. In addition, these new services benefit by certain fixed installations belonging to the railway (stations, depots) or new installations for common use provided by the working plan; in one word they have more of a *railway flavour* than ordinary motor services.

Naturally, they also cost *more*; this is why the law allows for the possibility of paying the annual operating subsidy also for those sections of railway which have been replaced, a subsidy which no doubt is very much less than that which would have been required had the railway services been retained, but which guarantees the satisfaction of public interests.

5. THE ROUTES AND THE CO-ORDINATION OF INVESTMENTS.

CONCLUSIONS

There is, however, a further problem which lies outside the powers of the Transport Administration: that of the routes. Whereas in the case of local

tramways the suppression of the lateral track makes the adjacent road sufficient (which is one reason why nearly all the suburban tramways have been replaced), in the case of railways with a separate road-bed, more than 25% of the services, run by the replacement motor undertakings, have to be made over roads that are unsatisfactory, either because they are not wide enough, or their layout and profile is unsatisfactory, or because they are not properly metalled.

These are most often side roads or local roads. It would certainly be desirable to increase the power of this rather feeble network of roads, now destined to carry the traffic (passenger and freight) of the secondary railways that are going to be given up. But at the present time, on the contrary, the largest sums are being spent on the main roads, in particular to the network of parallel autostrada, in other words those which are recognised as irreplaceable, and on which considerable capital has been invested and will continue to be invested in order to increase their capacity.

The road programme therefore does not agree with that of the railway. The State — and we think that this is the case not only in Italy but elsewhere — has invested enormous sums in both of them, for the same itineraries and for the same objects. Doubling is therefore inevitable, as well as the poor utilisation of the capital invested.

We are very far from co-ordination of investments, which is a preliminary condition of co-ordination and collaboration in the working of transport.

The replacement of the anti-economic lines does not bring us to the end of the

problems of the reorganisation of the concessionary railway lines. There is the equally fundamental problem of *assuring the vitality of the lines retained* for a sufficient period (the law lays down for this purpose 25 years).

It is not only a question of taking technical steps as regards the work of development and transformation, but also of affirming, according to the principles of discrimination, its corollary, the *protection of the traffic* on the remaining lines, whose installations have been developed at considerable capital expense. The theory of social costs, which shows the advisability of replacing the lines in the cases we have seen, also shows that taking away traffic from a modernised line intended to continue in operation *always* involves increased social costs.

It is therefore necessary to solve the question of open competition detrimental to the surviving railway lines: the Administration is devoting as much attention as it can to this problem.

There is no doubt but that the operation of rationalisation, once completed, is profitable; in effect, a comparison of the operating subsidies given to the 3 270 km of line studied by the Commission with those which will have to be given after the work has been carried out, shows an annual saving of about 1 950 million Lire: a real figure when it is remembered that it corresponds to a great extent to the number of licensed employees. The Treasury will therefore receive a remuneration corresponding to a capital investment of 18 thousand million Lire formerly spent.

Above all, however, there is no doubt that the application of the law on mo-

dernisation has sown in the field of railway organisation linked up with the concessionary system the seed of a revival and effective renewal which, if it is fertilised by a coherent policy, will lead to a certain economic stability. It is also obvious that to give the hoped for harvest of economic stability, the infinitely

vaster and more important field, as far as Italian economy is concerned, of the State Railways must also be harvested, where equally urgent and bold steps are also needed on a much larger scale, which will have a real effect upon the essential elements of the complex situation of this large undertaking.

Package dynamics,

by L. B. BANKS, M. I. Mech. E.,

British Railways Research Department.

Packages sent by rail are subjected to two principal hazards, they may be dropped, accidentally or deliberately, during handling or the vehicle in which they are placed may have its velocity suddenly changed due to shunting, braking or starting impulses. Only packages light enough to be moved by one or two men are commonly subjected to handling shocks, but all classes of goods are liable to damage by journey shocks. Present designs of mechanised yards tend to operate with impact speeds in excess of those used in manual yards.

Consignors frequently enquire what maximum acceleration their packages must be designed to withstand. If a rigid wagon were to impact a rigid stop then in theory the acceleration imparted to the wagon would be infinite, no matter how slow the speed of impact. Of course no wagon is really rigid, it has an elastic framework and is fitted with spring buffers, although those buffers now in general use go solid when a speed of about 4 m.p.h. (6.4 km/h) is reached. Measurements show extremely high accelerations of very short duration, but in such circumstances the maximum acceleration recorded is likely to be more a function of the frequency response of the instrument than a measure of the real peak acceleration experienced.

Figure 1 shows the typical force-time record of a collision between two 16 $\frac{1}{2}$ ton mineral wagons at just under 10 m.p.h.

(16 km/h). The force was measured directly behind a buffer, it is the force per buffer and the total force on the wagon is twice this.

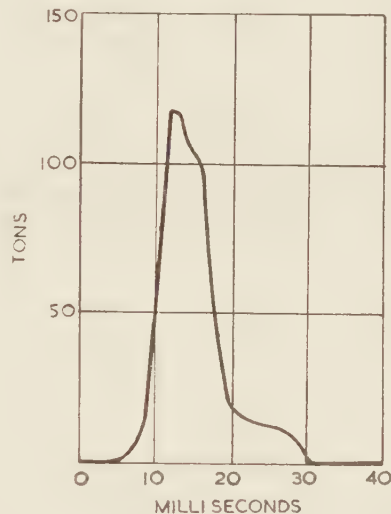


Fig. 1. — Force-time diagram of a typical shunting impact.

Collision at 9.6 m.p.h. between two empty 16 ton mineral wagons, one pair of « self-contained » rubber spring buffers and one pair of standard rubber buffers.

The safety or freedom from damage of most packages is governed by the extension which can be allowed in some member which can be thought of as a spring acted on by inertia forces due to attached mass, the strain in this member is limited for example by the elastic limit of the material,

or alternatively by the packing with which the article is surrounded, which must not be so much compressed that the article

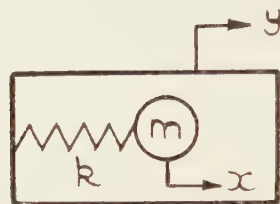


Fig. 2. — The idealized package.

hits the side of its case. Most vulnerable items of freight can therefore be idealised as a mass m attached to a case by a spring with elastic constant k as shown in figure 2. The sort of shock which we have been discussing, that is a rapid change in velocity, can also be idealised as in figure 3; in figure 4 is shown the acceler-

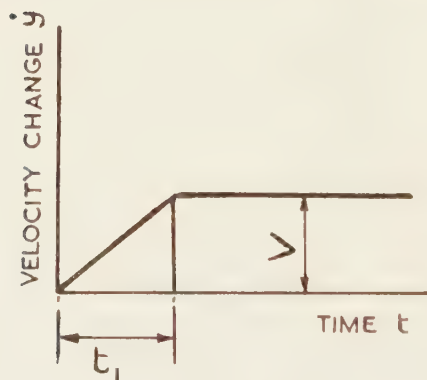


Fig. 3. — Idealized impact.

ation which will be experienced under such impact conditions. It will be readily appreciated that for any given velocity change the shorter the time taken the greater the acceleration. If it is agreed that the extension of some member must be limited to a given distance if damage to

the package contents or article are to be prevented, then the necessary conditions are illustrated by the Kornhauser diagram (*), this is shown in figure 5. In this

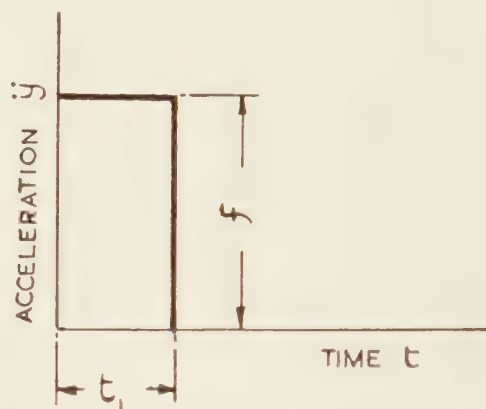


Fig. 4. — Acceleration in idealized impact.

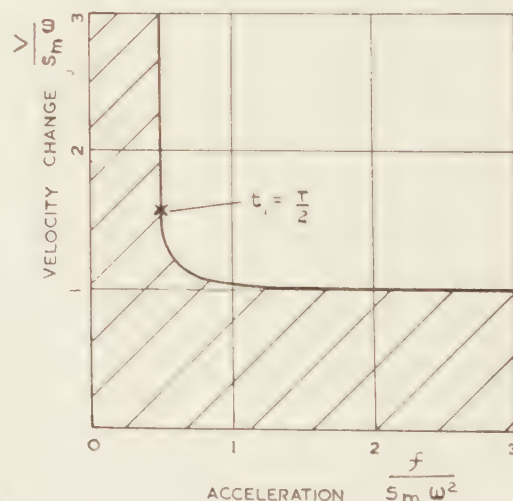


Fig. 5. — Velocity change-acceleration, the « Kornhauser » diagram.

(*) See M. KORNHAUSER : « Prediction and Evaluation of Sensitivity to Transient Accelerations », Journal of Applied Mechanics, Vol. 21, No 4, Dec. 1954, p. 371.

diagram velocity change is plotted against acceleration for a given allowable extension, points in the shaded zone represent extensions less than the allowable extension and therefore are safe, whereas points above and to the right of the curve represent extensions which are greater than can be tolerated and are unsafe.

The important thing to note is that, providing the velocity change does not exceed a given amount, the acceleration can be infinite without causing damage, this of course implies that the duration of the shock must be small, small that is compared with the natural period of the package. If the natural frequency of the freight is high, for example in the case of glassware, then steps must be taken to lower it, by packing it in a soft resilient material. If however, the acceleration were low, then the package could endure large velocity changes, which would take place over a relatively long time. In railway working this would represent the

acceleration required to move the train from rest or during controlled braking; in neither case is the acceleration likely to be high enough to cause damage to freight. Such damage might conceivably arise in aeroplane transport where wind gusts or air pockets can cause high accelerations of relatively long duration.

The diagram illustrates clearly the futility of quoting acceleration figures alone to guide consignees in the amount and kind of protection their freight is likely to require. Handling and journey shocks are both impulsive in nature and as their duration is likely to be less than the natural frequency of any well designed package it is far more helpful to be able to quote the maximum velocity change which will have to be dealt with. This information can easily be translated into terms of a standard drop test since any given height of drop represents a certain velocity of impact. Thus in Table 1 the velocity change in m.p.h. is correlated with the height of drop in feet :

TABLE 1.

Velocity Change m.p.h.	2	4	6	8	10	12	14
Ht. of drop ft.	0.1	0.5	1.2	2.1	3.3	4.8	6.5

Table 2 gives the same information but in km/h and cm :

TABLE 2.

Velocity Change km/h	4	8	16	20	24
Ht. of drop cm	6	25	100	157	226

Thus if we can say that the maximum change of velocity a freight van will meet will be a shunting shock of 10 m.p.h. (say 16 km/h) then any article in the van will be safe (providing it is properly stowed) if it has been designed to stand a drop of 3.3 feet (or 100 cm). This almost certainly errs on the safe side as in practice the wagon buffer and perhaps of more importance the elasticity of the wagon, both tend to mitigate the blow, nevertheless if complete safety of the article is required then it should be designed to withstand this drop. However, some research is really needed here and there is the possibility that the platform of a standard drop test might be slightly sprung to represent the protection afforded by the wagon. This might tend to make the drop test simpler and more reproducible. If the article is flat sided however, it need only be capable of withstanding the impact of the floor flat against any face, not on a corner; only to assess its resistance to handling shocks is the dropping on a corner a required test.

In conclusion therefore, it is suggested that the concept of the maximum acceleration which any vulnerable freight must be capable of resisting be abandoned as it is useless without a knowledge of the duration of the impulse. In its place for shock loading the velocity change should be substituted; this is a figure the limits of which can be readily assessed by any railwayman and a knowledge of which enables the packer to test the quality of his product by correlating it with a standard drop test.

Due acknowledgment is made to many helpful criticisms from the author's col-

leagues and to the Director of Research, Mr. T.M. HERBERT, for permission to publish this article.

APPENDIX

The behaviour of a package under the influence of a rectangular acceleration pulse.

Below the dynamics of a package are developed and the method of deriving the Kornhauser diagram described. This method is a little different from that in the article quoted as it is felt that those readers who are not mathematicians would prefer a more classical approach.

For the idealised package as shown in figure 2 the equation of motion is :

$$m\ddot{x} + k(x - y) = 0 \quad \dots(1)$$

If $\omega = \sqrt{k/m}$ (the natural, radial frequency of the article)

$$\text{then} \quad \ddot{x} + \omega^2 x = \omega^2 y \quad \dots(2)$$

It is necessary to consider the solution of this equation in two parts, first during the period of acceleration and second, when the acceleration has ceased at the end of time t as shown in figures 3 and 4.

Part 1 :

$$t \leq t_1 \text{ i.e. } \ddot{y} = f$$

$$\text{when :} \quad t = 0 \quad y = 0$$

$$\text{hence :} \quad y = \frac{ft^2}{2}$$

$$x + \omega^2 x = \frac{ft^2}{2} \omega^2$$

the solution of this is :

$$x = \frac{ft^2}{2} - \frac{f}{\omega^2} + A \sin. \omega t + B \cos. \omega t$$

where A and B are arbitrary constants.

Taking x and $\dot{x} = 0$ when $t = 0$,

we have : $A = 0$ and $B = \frac{f}{\omega^2}$

$$\text{or : } x = \frac{ft^2}{2} + \frac{f}{\omega^2}(\cos. \omega t - 1) \quad \dots(3)$$

Let $s = x - y$, i.e. s is the displacement of the article relative to the case, it is the stretch of the spring or a measure of the strain in some part of the article.

$$\text{Then } s = \frac{f}{\omega^2}(\cos. \omega t - 1) \quad \dots(4)$$

the maximum value of s , say $s_m = \frac{-2f}{\omega^2}$ and this occurs when :

$$\omega t = \pi \text{ or } \frac{t}{T} = \frac{1}{2}$$

where T is the natural period of vibration of the article, i.e. $T = \frac{2\pi}{\omega}$.

If the acceleration f were built up very gradually then :

$$s_m k = -mf$$

$$\text{or : } s_m = -\frac{f}{\omega^2}$$

the maximum value of s is therefore doubled by reason of the sudden application of the acceleration, i.e. the dynamic magnification due to this type of impulse is 2.

Part II :

$$t > t_1 \text{ and } \ddot{y} = 0$$

\ddot{s} will therefore be equal to \ddot{x} and the equation of motion is now therefore :

$$\ddot{s} + \omega^2 s = 0$$

and the solution is :

$$s = C \sin. \omega t + D \cos. \omega t \quad \dots(5)$$

C and D being the arbitrary constants, the motion at the beginning of Part II is obtained by putting $t = t_1$ in equation (4) i.e. it is the motion at the end of Part I.

This gives :

$$s = \frac{f}{\omega^2}(\cos. \omega t_1 - 1)$$

$$\text{and : } \dot{s} = -\frac{f}{\omega} \sin. \omega t_1$$

substituting these values in (5) gives :

$$\begin{aligned} C &= -\sin. \omega t_1 \\ D &= 1 - \cos. \omega t_1 \end{aligned}$$

Hence :

$$s = \left[(1 - \cos. \omega t_1) \cos. \omega t - \sin. \omega t_1 \sin. \omega t \right] \frac{f}{\omega^2} \quad \dots(6)$$

By differentiating (6) and equating to zero we can find the maximum displacement :

$$s_m = -\frac{2f}{\omega^2} \sin. \frac{\omega t_1}{2} \quad \dots(7)$$

When the duration of the acceleration becomes very small i.e. $t \rightarrow 0$:

$$s_m = -\frac{ft_1}{\omega} = \frac{V}{\omega} \left[(\dot{\cdot} \cdot V = ft_1) \right]$$

note that the displacement is independent of the acceleration alone and that this may be infinite.

The maximum value of s_m is reached

$$\text{When : } \frac{\omega t_1}{2} = \frac{\pi}{2}$$

$$\text{i.e. } \frac{t_1}{T} = \frac{1}{2}$$

(When $\frac{t_1}{T} > \frac{1}{2}$, s_m will have passed the

first maximum value, as we have assumed no damping this maximum value will be repeated, in practice we can disregard this as there will always be some friction).

$$\text{from (7): } \frac{f}{s_m \omega^2} = - \frac{1}{2 \sin. \frac{\omega t_1}{2}} \quad \dots(8)$$

$$\text{and: } \frac{f t_1}{s_m \omega^2} = \frac{V}{s_m \omega^2} = - \frac{t_1}{2 \sin. \frac{\omega t_1}{2}}$$

$$\text{or : } \frac{V}{s_m \omega} = - \frac{\omega t_1}{2 \sin. \frac{\omega t_1}{2}} \quad \dots(9)$$

The quantities $\frac{f}{s_m \omega^2}$ and $\frac{V}{s_m \omega}$ may be regarded as the dimensionless

acceleration and the dimensionless change of velocity. They are respectively the ratio of the actual acceleration to the acceleration required to produce the displacement experienced if the acceleration were applied gradually, and the ratio of the actual velocity change to the velocity

which must be given initially to the mass to produce the maximum extension without any acceleration.

Unfortunately it is not possible to eliminate t_1 algebraically between equations (8) and (9); it may easily be done graphically however, by tabulating the

values of $\frac{f}{s_m \omega^2}$ and $\frac{V}{s_m \omega}$ for various values

of ωt_1 and plotting each pair of values as has been done in figure 5. It should be noted that equations (8) and (9) only

apply for values of $\omega t_1 \leq \pi$ i.e. $t_1 \leq \frac{T}{2}$

for greater values of t_1 relative to T the maximum value of the displacement will have occurred before the acceleration ceases and the equations will be those of Part 1.

Automatic stopping of trains by magnetic control device,

by Siegfried BAUMGART and Kurt BUDER.

(*Siemens Zeitschrift*, No. 9, September 1957.)

The protection of trains against the dangers arising from non-compliance with stop signals requires equipment acting on trains in motion, from the track, and capable of bringing them to a halt without any action from the train crew.

Formerly, *mechanical devices* were used for this purpose. With these, a lever or friction bar came into contact with the vehicles when the signal was at danger which caused the tripping of a lever to open the main train pipe and stop the train. However, the control devices which incorporate mechanical parts are comparatively expensive and require a good deal of maintenance as the moving parts are subject to wear. Moreover, they are not suitable for high speeds, because it is difficult to determine the mechanical stresses. In addition, they are suitable only for one direction of travel.

When operating requirements are severe, and require control of the driver's degree of alertness, control of the braking at warning signals as well as determination of speed up to stop signals or danger points, it is necessary to consider the following provisions:

- effect on the train, without the use of moving mechanical parts;
- suitability for all speeds in use;
- distinction between several aspects and ability to transmit them to the train;
- application to double track as well as single track;
- operation if necessary, without electrical energy for the transmission device sited on the track;

— operation, as regards train equipment and if necessary track equipment, on the « permanently energised » principle, so that under fault conditions, such as current failure, breaking of the circuit, etc., they will be in the safe position.

Amongst the various methods of dealing with the problem, two types of equipment built by Siemens and Halske were particularly successful:

- the multi-frequency resonance inductive system, and
- the permanent magnet system.

The first, which has the abbreviated trade name « Indusi » ⁽¹⁾ is suitable for very severe operating conditions, such as main lines, because of the high speeds and the need for several indications to the train within the braking distance. Another essential consideration is that the device can be operated without the source of current for the track equipment, as the great majority of main line signals are still mechanically operated so that there is no electrical energy laid on to the track.

The *permanent magnet system* which we describe below finds its main applications on surface or underground railways, fast urban lines, suburban lines and industrial lines (fig. 1). The first installations of this kind were used soon after 1930, with good results. After the war, there were further improvements. It has been pos-

⁽¹⁾ M. MILLER: « Sicherung des Eisenbahnverkehrs durch induktive Zugbeeinflussung » (Protection of railway operation by inductive automatic train control). « Siemens Zeitschrift », 30 (1956), pp. 58 to 63.

sible to introduce basic improvements, particularly in the method of transmission, because of new magnetic materials.

Method of operation.

Figure 2 shows in a simplified form the track and train equipment. The track

magnet the flux of which, directed upwards, is captured by pole pieces of the train magnet (2) and carried to the relay (3). In construction and mode of operation, this relay resembles a polarised relay, with the difference that the flux, which operates the armature when excited, is not produced by a coil of the relay



Fig. 1. — Signal with track magnet for automatic magnetic braking (Hamburg Metro).

apparatus consists basically of a magnet (1) which is arranged approximately in the centre of the tracks level with the signal. This track magnet is a permanent

itself but is taken from outside by the pole pieces. The relay contact is closed in its original position and inserted in the circuit of a brake relay (4) located

in a case with the other parts of the apparatus.

Connected to the main train pipe (5) is the emergency brake valve (6). This has two balanced pressure chambers one of which is connected by a small diameter

magnet, the magnetic flux controlling the train magnet causes the inversion of the relay contacts (3). The current circuit is interrupted and the relay (4) is de-energised. Its armature opens the valve relay which causes one chamber of the emer-

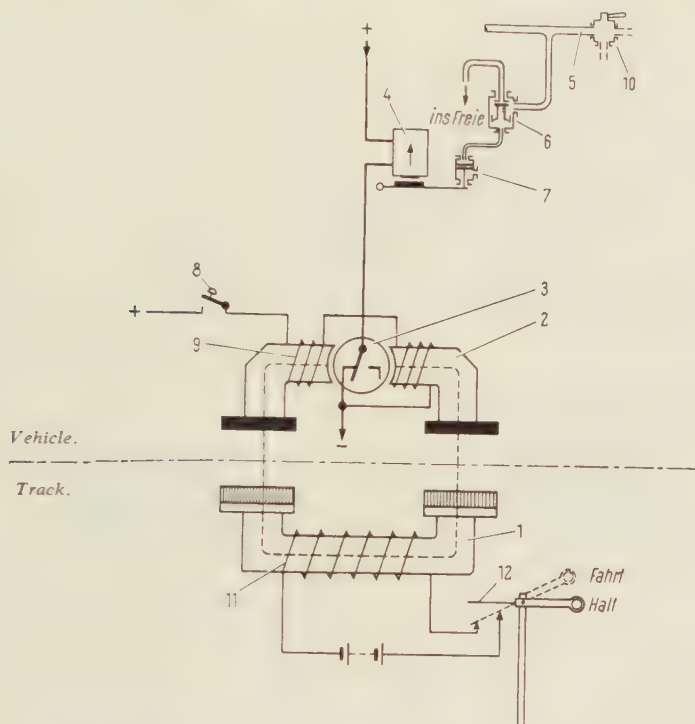


Fig. 2. — Principle of automatic brake application by permanent magnet.

- | | |
|----------------------|---------------------------|
| 1. Track magnet. | 7. Valve relay. |
| 2. Train magnet. | 8. Cancelling button. |
| 3. Magnetic relay. | 9. Auxiliary winding. |
| 4. Brake relay. | 10. Driver's valve. |
| 5. Train brake pipe. | 11. Neutralising winding. |
| 6. Emergency valve. | 12. Signal contact. |

N. B. — Ins Freie = in open air. — Fahrt = running. — Halt = stop.

tube to the feed valve relay (7) and the other to the main compressed air pipe. The armature of the brake relay holds this valve in the closed position.

When the train passes over the active

gency valve to empty. The diaphragm of this valve is opened to atmosphere so that the whole of the train brake is applied. When the train is stopped or sufficiently slowed down, the forced braking can be

cancelled by a push button (8). Its operation closes the circuit for an auxiliary winding (9) which restores the relay contact and returns the brake relay to its original position. The depression of the button is recorded on a chart. The main compressed air pipe can then be refilled by means of the driver's valve (10). The train is then ready to start again.

When the signal shows a « clear » road, the corresponding track magnet must have no effect on the train. For this purpose, the track magnet has a neutralising winding (11), which, when the signal is open, is fed through a signal contact (12) by direct current, or in the case of colour light signals by the current of the signal in the open position. As we shall explain later, it thus becomes impossible for the track magnet to affect the train magnet.

Magnetic phenomena in the track and train magnets.

The path of the magnetic flux in the two magnets is shown in figure 3. The train magnet is shown in the position it takes up when it is operated. The direction of travel must be imagined along a perpendicular to the plan.

The track magnet has a soft iron core (15) arranged horizontally, at the ends of which are two plates also of soft iron (14) to which are fixed the permanent magnets (13). They are magnetised in a vertical direction as shown by the blue line which represents the flow of flux when the apparatus is activated. The magnets are made of a material with a very high coercive force, the ratio of their length in the direction of magnetism to their section can thus be very low. The flux from the north pole of the left hand magnet is received by the left hand pole piece (16) on the train, penetrates the core of the coil (17) passes from the flux lead (22) to the armature (19) crossing the air gaps (18) and then arrives, by way of the core of the coil (17), pole piece (16) at the south pole (13) of the right hand per-

manent magnet. The control of flux in the armature air gap is shown in a more detailed manner in figure 4. The armature (19) is hung in an axis of its centre of gravity by a return ring (20) and can pivot around it. Its left hand end moves in the gap between the two soft iron pieces (25) which receive the polarisation flux produced by the magnet (21) through two yokes. The path of the polarisation flux is shown by red arrows. The control flux taken from the track is shown by blue arrows. It is also received by the two soft iron pieces through the flux lead (22), passes from there to the armature which it crosses longitudinally and leaves at the extreme right. It will be seen that from one side of the armature the two fluxes are directed in the same way and from the other side in opposite ways. With the directions shown by the arrows in figure 4, the armature is moved when the equipment is operated in the direction of the left hand soft iron piece, because from that side the control flux and polarising flux are focussed in the same direction.

In this position, a contact on the armature breaks the circuit of the brake valve relay which, as already described, causes the opening of the feed valve. The armature remains in this position until the cancelling button is pressed (8, fig. 2). The auxiliary winding (9) receives direct current through this contact and thus sets up a control flux in the reverse direction to the flux received from the track magnet. This control flux moves the armature towards the front iron piece, that is towards its original position.

With a polarised relay, the armature can pass longitudinally either the polarisation flux or the control flux. These two conditions are shown in figure 5. On the left, the armature is traversed by the whole of the polarisation flux. It is composed of two parts, Φ_1 and Φ_2 . The force exerted on the armature in the absence of control flux is proportional to Φ_A ($\Phi_1 - \Phi_2$) and consequently is always less than Φ_A^2 . In order that the armature can turn suf-

ficiently quickly at high speeds of running it is essential that its moment of inertia and consequently its section should be small. Because of the saturation, the flux Φ_A cannot exceed a certain maximum. Therefore the force which can be exerted

For this reason, the magnetic receiver of the automatic stopping equipment has an arrangement corresponding to that shown on the right of figure 5. In this arrangement the whole of the polarisation flux passes through the upper pole piece. It

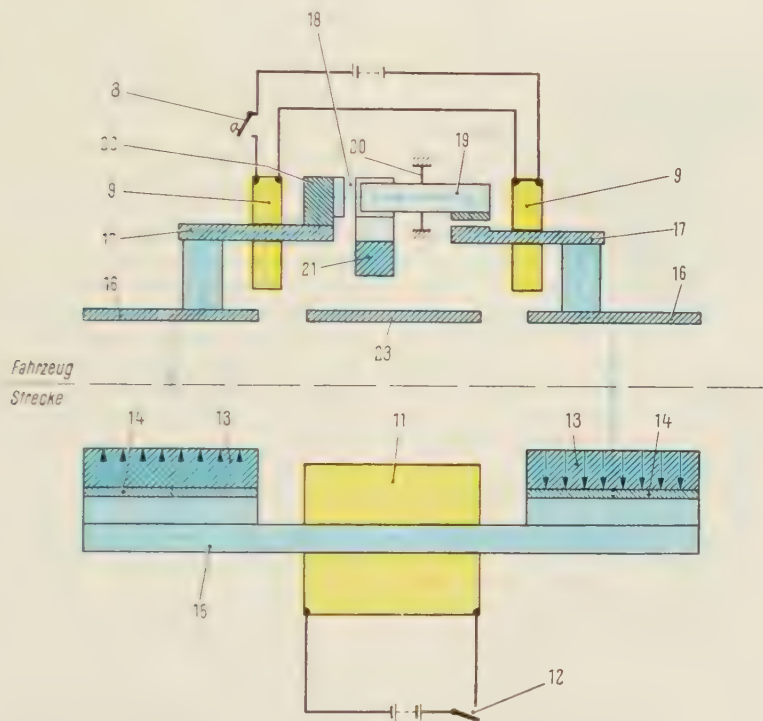


Fig. 3. — The magnetic circuit.

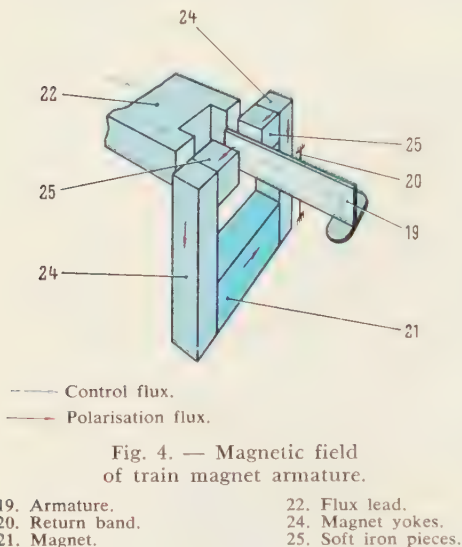
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|------------------------|------------------|
| 13. Permanent magnets. | 19. Armature. |
| 14. Soft iron plates. | 20. Return band. |
| 15. Soft iron yoke. | 21. Magnet. |
| 16. Pole pieces. | 22. Flux lead. |
| 17. Coil cores. | 23. Shunt plate. |
| 18. Air gap. | |

N. B. — Fahrzeug = vehicle. — Strecke = track line.

on the armature in the absence of control flux is also limited. It is, however, desirable to give this force a value as high as possible in the receiver of the automatic stop equipment of the train, so that the apparatus is not upset by vibration.

is made up of a portion Φ_A which crosses the armature and a portion Φ_2 which is received by the lower pole piece. The force exerted on the armature when there is no control flux is proportional to the product $\Phi_A (\Phi_1 + \Phi_2)$. The amount

of this force can thus be increased independently of Φ_A by increasing by the required amount the section of the soft iron pieces which carry the polarisation flux, and consequently the factor $\Phi_1 + \Phi_2$. In practice, this arrangement makes it pos-



sible to have train magnets sufficiently insensible to vibration to permit them to be used on an unsprung vehicle.

By the use of a permanent track magnet, the installation meets the need for reliability under fault conditions, such as cur-

rent failure, breaking of wire or maloperation of contacts.

As shown in figure 2, the current supply feeds only the neutralising coil of the track magnet, the magnetomotive force of which is opposed to the permanent magnet when the signal is clear, and prevents the train magnet operating. In the event of a fault in the circuit of the neutralising coil, the train would be automatically braked at a clear signal which would immediately show the existence of a fault.

Fields of magnetic disturbance from running rails used for traction return current (fig. 6), in particular when starting or when there is a short circuit, are completely overcome with the permanent magnet system. The sensitivity of the train magnets can always be arranged to avoid them being operated within the maximum magnetic disturbance experienced on the railway concerned. For this purpose, a shunt plate (23, fig. 3) is provided to give a path parallel to the armature for the magnetic flux absorbed by the pole pieces (16). The width of this plate is adapted to suit the operating conditions. In addition, the intensity of the field produced by the track magnets is calculated so that it will be sufficiently below the value of the disturbance field set up by the traction currents.

The spacing between the track and train magnets is governed by track conditions. Variations are governed by rail and tyre wear as well as by the deflection of the bearing springs when the vehicle magnet is fitted to the spring portion. At the minimum spacing, the equipment must not be operated by the neutralised track magnet. At the maximum spacing the response to the active track magnet must be positive, even at the highest speed, and also at the maximum transverse displacement of the vehicle, as could occur on a curve, for example.

Normal equipments operate between variations of spacing from 30 to 150 mm with a transverse displacement of up to

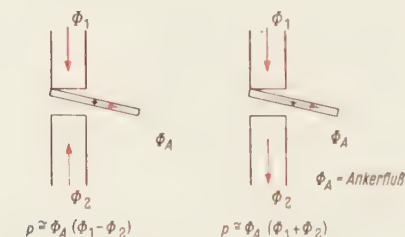


Fig. 5. — Action of polarisation flux on the armature.

Left: armature in the polarising circuit.
Right: armature in the control flux circuit.
N. B. — Ankerfluss = armature flux.

50 mm and speeds reaching 200 km/h (124 m.p.h.).

Figures 1 and 9 show the exterior of the track magnet, figures 7 and 9 an exterior view of the train magnet.

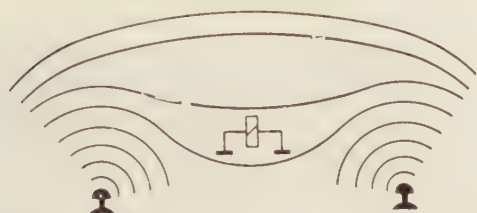


Fig. 6. — Field of magnetic disturbance from current in the rails.

Figure 7 also shows the rubber pads inserted between the suspension brackets and the casing to prevent transmission of heavy shock to the equipment.

Examples of use.

The system of magnetic transmission described can act on a train in various ways, according to operating conditions and requirements. For example, the following are cases of installation on new lines:

1. Automatic magnetic braking for stop-

ping trains at danger signals on the surface and underground Hamburg lines;

2. Automatic magnetic braking with brake application and signal observance recorded on 120 t industrial locomotives at the « Rhenish lignite mines and briquette works Company » at Cologne;

3. Automatic magnetic braking with control of speed at stopping distances in advance of signals at danger, and for stopping trains at such signals, on the Turkish line between Sirkeci and Soguksu.

From the first example, we will describe the interaction of the magnetic brake equipment and the train brake equipment, and also the operation of the equipment by the train crew.

1. Magnetic braking as automatic stop at danger signals.

Arrangement of the equipment.

In the driving cab (fig. 8) is the equipment box. Near to this are the « pneumatic » parts — pressure gauge, auxiliary reservoir and emergency valve (the two latter are not shown in the illustration).

The train magnet has a rubber and metal suspension under the vehicle in front of the leading motor casing (fig. 9). It is inside the statutory rolling stock gauge



Fig. 7. — Track magnet (open).

about 95 mm above rail level, at a certain distance from the track centre, so that the field of disturbance from rail connections carrying traction current do not affect the train magnet. This magnet is connected to the equipment case by a tagged cable. In operation, the automatic control requires about 0.5 A at a continuous tension of 24 V. For reason of safety, a special accumulator battery is provided, continuously recharged.

Operation.

To compel the train crew to set the installation in working order before taking up a normal service, there is a locking key. Introducing the locking key into the keyhole provided for the purpose, the automatic brake is brought into operation and at the same time the running controller for forward or reverse running can be released and brought to the working position. Instead of this lever, the key of the drivers's valve can be used for the purpose. The external visible indication of the control setting is a pilot lamp.

Figure 10 shows the possible operating conditions.

Passing a « clear » signal.

When a vehicle approaches a green signal, showing a « clear » road, no operation is needed. The track magnet is made inactive because the neutralising coil is put in circuit by the signal contact.

Action to be taken when passing warning signals.

On the different block sections of line, the trains are protected by signals which do not show a red aspect, as « home » signals do, but a yellow aspect, signifying a cautionary signal which may be passed (permissive signal). At these signals, trains must stop but can then resume running subject to certain conditions. This arrangement is necessary to ensure that operation of trains on the line is not held up longer than is necessary in the event of faults in the sectioning and signalling arrangements.

In order to pass, without automatic brake application, the active track magnet of a signal of this kind the driver must press the release button. The freeing is recorded by a recorder and a « release » pilot light is illuminated. Through the

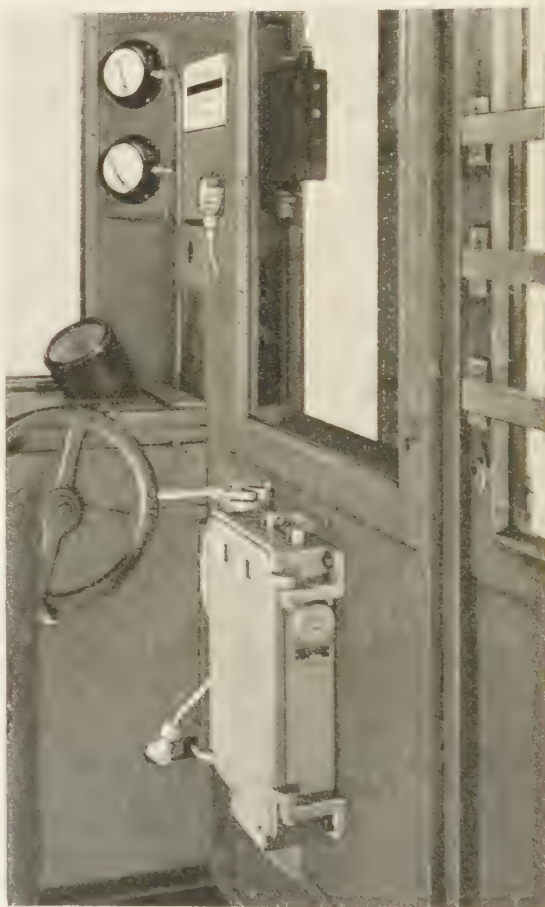


Fig. 8. — Arrangement of equipment in cab of a Hamburg Metro motor coach.

action of a time lag relay, the train magnet is made inoperative for about 25 seconds by excitation of the windings; the train can thus pass the signal. At the end of this time the train magnet is re-

activated. The « release » light continues to burn and can only be put out by an inspector by means of a special key.

The train passes a « stop » signal.

If the driver through inattention, passes a warning signal (« yellow aspect ») or even a stop signal, automatic brake application follows immediately, because in cases of this kind the track magnets are active. The siting of stop signals is generally arranged so that there remains beyond it a sufficiently

mature brake release. For this purpose a delay chamber with a no-pressure valve is provided. The air escapes slowly from the delay chamber through a small hole, in the event of forced braking and only after about 20 seconds is it possible to make the contact which re-excites the brake valve relay and returns the train magnet relay to its original position.

A pressure gauge shows the drop in pressure in the pipe and when it is possible to cancel the forced braking. Therefore a

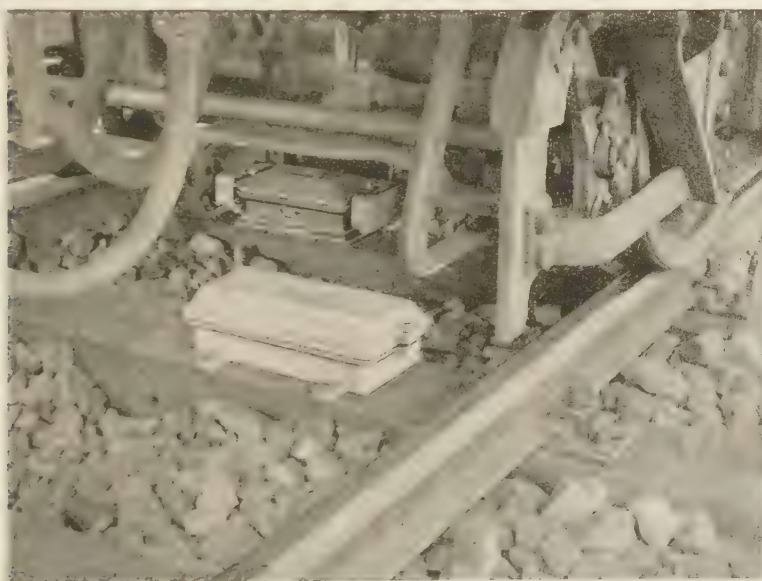


Fig. 9. — Track and train magnets in working position.

long protective distance before the point of danger, having regard to train braking capacity.

If the driver takes no action, the braking will continue until the train is halted. At the same time, to avoid the wheels locking the driver can after the train pipe has been sufficiently emptied, i.e. when the brakes are fully applied, cancel the heavy forced braking and make it progressive. However, care must be taken to see that it is not possible to make an erroneous pre-

double numbering of the forced braking is avoided. The action of the driver is not only recorded, it is also shown by a red indicator light mounted on the equipment case. This lamp can be extinguished only by an inspector.

This automatic magnetic stopping equipment is at present being fitted to 450 vehicles of the Hamburg metro and on all underground and surface lines. The increased safety thus provided has enabled the use of one man only in the driving cab.

2. Magnetic braking, with control of brake application and driver's «vigilance».

The problem to be resolved on the industrial lines of the «Rhenish lignite mines and briquette works Company» are as follows:

Trains for conveyance of lignite and gangue are hauled when full and propelled when empty; pulled and pushed trains

signal receives first at P_1 , under the effect of an impulse from the track magnet, an audible signal in the cab; if the driver has not already commenced to apply the brake, he must within the next 5 seconds apply the electric or pneumatic brake and confirm that he has seen the signal by pressing a control button. If one of these two operations is not carried out, or if the

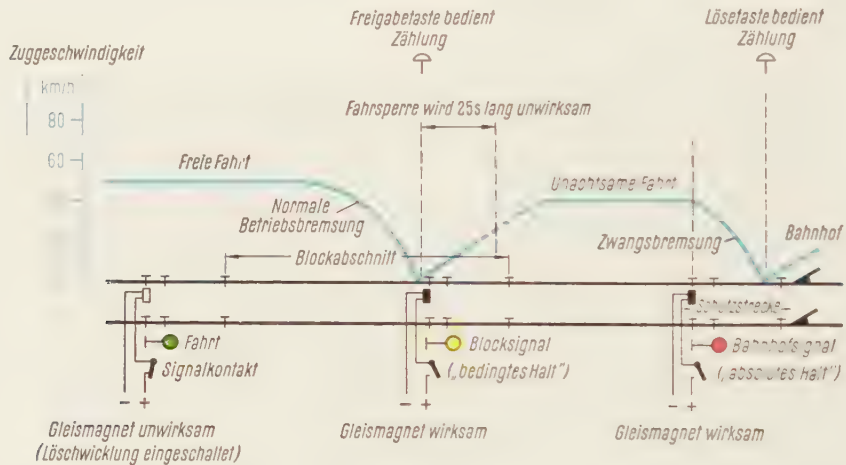


Fig. 10. — Arrangement of signals on Hamburg Metro.

N. B. — Zuggeschwindigkeit = running speed. — Freie Fahrt = running free. — Normale Betriebsbremsung = normal service braking. — Blockabschnitt = block section. — Freigabefaste bedient (Zählung) = cancelling button used (number). — Fahrsperr... = automatic stop not effected for 25 seconds. — Unachtsame Fahrt = wrong running. — Lösetaste bedient = cancelling button used. — Bahnhof = station. — Zwangsbremsung = automatic braking. — Schutzstrecke = protective section. — Fahrt = track free. — Signalkontakt = signal contact. — Blocksignal (bedingtes Halt) = block signal (permissive). — Bahnhofsinal... = home signal (stop). — Gleismagnet wirksam = track magnet active. — Gleismagnet unwirksam (Löschwicklung eingeschaltet) = track magnet inactive (neutralisation winding in circuit).

can operate on each of the two tracks. As the track magnets must act on the locomotives, they must be located at a specified distance in advance of the signals (fig. 11). However, as every locomotive, even when propelling must draw up to the signal, it is not possible at point P_1 , to release by means of the track magnet, the automatic stop, but only to record brake application and compliance with signals.

The driver of a train approaching a stop

order is changed, the train brakes are applied within a maximum of 5 seconds. During this time the locomotive has arrived at P_2 . In the worst case, the locomotive of a hauled train will stop at P_3 and the leading end of a propelled train at P_4 , i.e. still within the protecting section.

On the opposite track, there are also track magnets, but the polarity is reversed (N-S and S-N respectively in the illustration). As all locomotives can work in either direction, they have two train

magnets, the appropriate equipment being brought into service by the locomotive reversing gear.

More than 100 industrial locomotives

3. Magnetic braking with control of speed and automatic stoppage at stop signals.

For the suburban line Sirkeci-Soguksu of the Turkish Railways, control of speed at

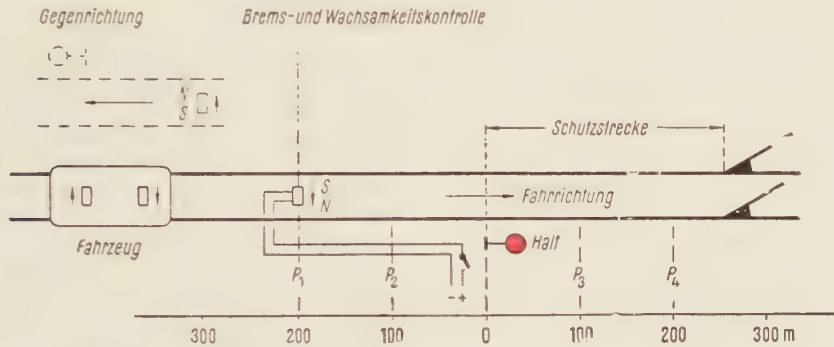


Fig. 11. — Arrangement of signals with brake and vigilance control on a mining railway.

0-P₁ Length of train + distance covered in 5 sec at maximum speed.

P₂ Latest time for commencing automatic brake application (distance covered in 5 sec).

P₃ Stop of a hauled train with automatic braking.

P₄ Stop of a propelled train with automatic braking.

N. B. — Gegenrichtung = opposite track. — Brems- und Wachsamkeitskontrolle = brake and vigilance control. — Schutzstrecke = protective section. — Fahrrichtung = direction of travel. — Halt = stop. — Fahrzeug = vehicle.

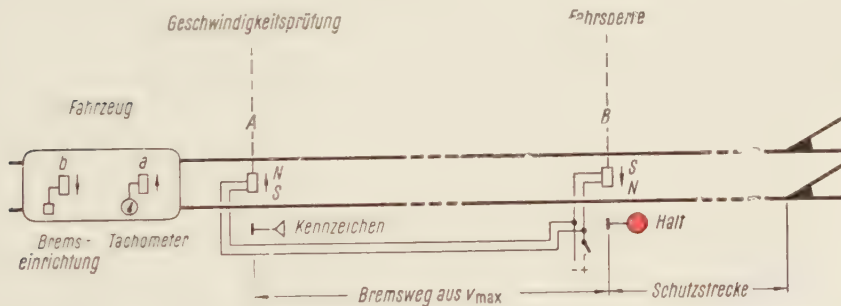


Fig. 12. — Arrangement of signals with control of speed and automatic stop on a Suburban line.

N. B. — Fahrzeug = vehicle. — Geschwindigkeitsprüfung = speed control. — Fahrsperr = automatic stop. — Brems-einrichtung = brake device. — Tachometer = tachometer. — Kennzeichen = indicator. — Halt = stop. — Schutzstrecke = protective section. — Bremsweg aus v_{max} = stopping distance at maximum speed.

have been fitted with this automatic brake, which provides an effective safety device and helps to ensure regularity of operation.

a stopping distance in advance of stop signals was required, in addition to automatic stopping. The speed control is

governed by a track magnet placed at a suitable distance in advance of the signal (fig. 12).

This track magnet *A* acts on the train magnet (*a*) and indicates the speed of the train, working in conjunction with a speedometer. If this is higher than the prescribed maximum, the train is immediately subject to automatic braking which brings it to a stand before the halt signal. If it is below the prescribed maximum speed, the train can continue to the stop signal without hindrance.

The second track magnet *B* is located near the signal and acts on the train magnet (*b*). This prevents overrunning, through error or negligence, of the stop signal. Automatic braking comes into

effect at once and stops the train, the speed of which has already been controlled by track magnet *A*, before the limit of the safety distance. Speed control and automatic brake application differ in track magnet polarisation.

This system has been applied to 36 motor coaches and 3 electric locomotives of the Turkish State Railways.

The examples quoted show the different possibilities of using magnetic braking to ensure safe running. They show that it is possible to provide without difficulty not only the application, pure and simple, of automatic braking, but also by varying the polarisation of the track magnets, to control speed, and ensure compliance with signals.

Five unit double decker articulated rake,

by Willy MÜSSIG,

Head of the Research Department, Górlitz Construction Shops.

(*Deutsche Eisenbahntechnik*, No. 11, November 1958.)

As we have already briefly reported, the first half rake of the new double decker articulated train was shown to the public on the 20th April 1957 during a special run on the Berlin Outer Circle Railway (¹). This light weight train, the result of collaboration between the Ministry of Transport and the Górlitz Wagon Construction Shops, was intended not only to realise a light weight construction by perfecting the old types of double decker vehicles, but also to find new solutions to the problem of the arrangement and suspension of the coach, as well as of certain of its parts, the transmission of stresses and the inclusion of stress-carrying sections in the coach body.

1. Exterior arrangement.

The very thorough studies made led to the designing of an articulated unit in eleven parts, consisting of two half rakes with a buffet coach (fig. 1).

The half rake consists of two end coaches

and three centre coaches of the double decker type, as well as four intermediate units (access units) which have no upper deck. The five « coach » units rest on six four-wheeled bogies without axle box guides.

The complete articulated rake, made up of two such half rakes, will have 1 280 seats in addition to the seats in the buffet car. These trains are to be run in fast services between the regional centres of the German Democratic Republic, as well as to meet holiday traffic requirements. The composition of the rake, as well as its arrangement, also makes it possible to run the half rakes without buffet cars in local and workmen's services. The different coaches are standardised so that not only do the points of suspension coincide, but the interior arrangement and installations are the same, which makes it possible to make up trains of any length required.

The principal technical characteristics of the articulated double decker rake are:

Length of articulated double decker rake of 11 units.	over buffers .	229 400 mm
Length of a half rake, over buffers		104 300 mm
Length of the buffet car, over buffers		20 800 mm
Length of end coach, between end walls		21 275 mm
Length of centre coach, between end walls		16 550 mm
Length of intermediate unit, between end walls		2 350 mm
Exterior width of coach		2 870 mm
Height from rail level to top of roof		4 650 mm
Height of floor above rail level, lower deck		380 mm
Height of floor above rail level, upper deck		2 500 mm
Height of floor above rail level, intermediate unit		1 185 mm
Bogie wheelbase		2 500 mm
Diameter of wheel tread running circle		950 mm
Minimum radius of curve		100 m
Number of seats		640/1 280
Tare of half rake		129 t
Weight per seat	approx.	200 kg
Maximum running speed		120 km (74 miles)/h
Loading gauge of vehicles according to appendix F of Operating Regulations.		

(¹) « *Deutsche Eisenbahntechnik* », t. 5 (1957), No. 5, p. 231.

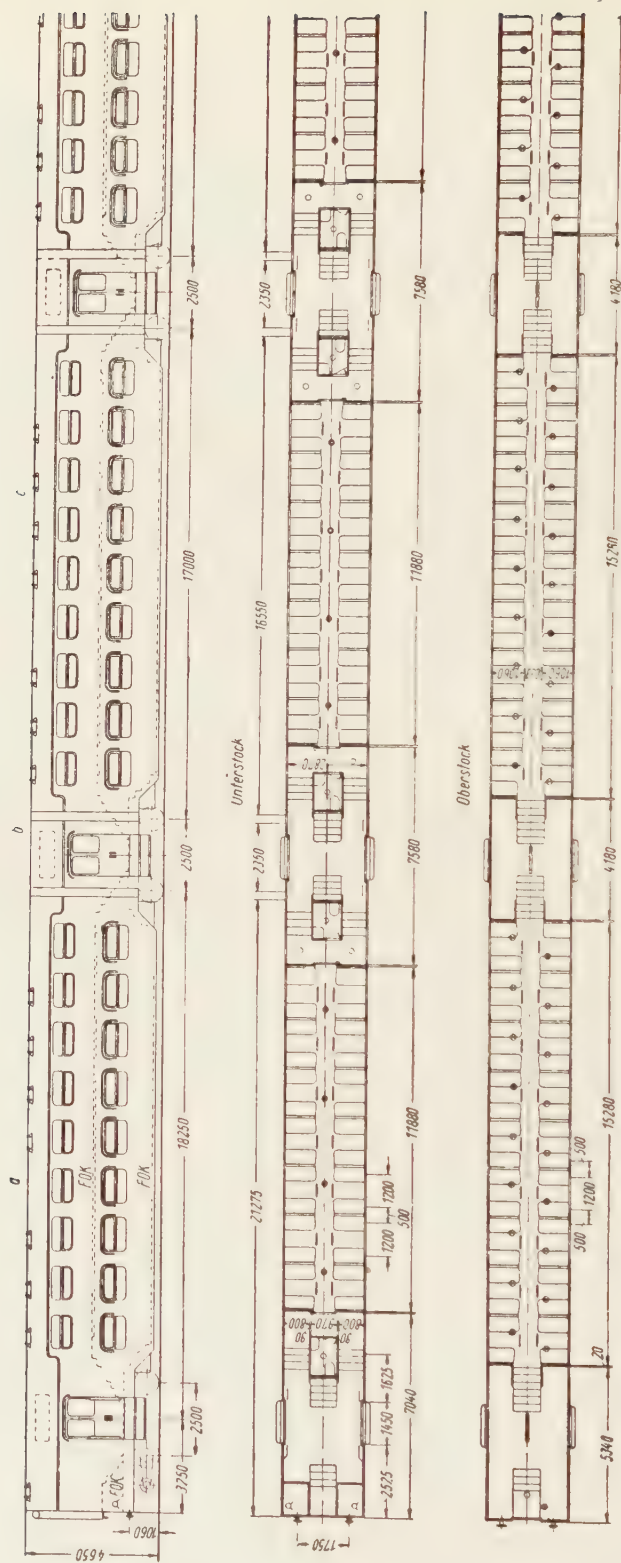


Fig. 1. Composition of the 5 unit half rake.

c. Coach body.

N. B. — Understock = lower deck, — Oberstock = upper deck, — FOK = floor level.

The principal characteristics of this articulated rake (fig. 2) are that the different coaches of the half rake are connected together by vestibules, the passage from one unit to another not being specially noticeable from the exterior. The coach units with rigid couplings have no end walls, so that passage from the centre portion to the intermediate unit inside the vehicle is hardly noticed by the passengers.

The articulated rake was specially studied to obtain a light weight design. This condition was met on the one hand by a new fixing of the optimum coach length in

consisting of making all the existing stress-carrying sections of the coach take part in the transmission of such stresses. For this purpose, these sections have not only been carefully designed as regards their shape, but have also been made resistant to twisting. To transmit the buffing stresses to the upper and lower curves of the stress carrying construction, use has been made of the existing doors in the ends of the centre coaches, and disguised in the arrangement of the vehicles in the form of the partitions of the toilets or stairway string. The stiffeners used to give the body of



Fig. 2. — View of the 5 unit half rake.

relation to its capacity, a new method of supporting the coaches together, a new division and distribution of the static and dynamic stresses exerted on the stress-carrying body and, on the other hand, by the use of an all steel self supporting type of coach, in which the lower false floor, the sides and the roof all share in the stress carrying construction. Thanks to the arrangement of stiffeners between the roof and the floor, as well as the side, the cross section of the coach has been made into a tube which resists shear and is included in the calculations.

For the transmission of buffing stresses, new methods have also been introduced,

the coach resistance to shear and transversal rigidity have also been designed in such a way that once the seats and luggage racks are in position only the vertical uprights can be seen in the passenger compartments. All the stress carrying parts are made of steel, of ST. 37 quality, welded; ST. 52 steel has only been used to a very limited extent. For the framework of the body, light sections of reduced thickness have been used, made of folded sheet in the first instance, but which can always be replaced by light rolled sections if necessary. The steel framework of the roof, sides and lower false floor have been welded to a smooth sheet steel covering.

The parts of the frame which overhang the bogies in the end coaches, as well as the frame of the intermediate units are so designed that the buffing forces applied to them, as well as the vertical stresses on the pivoting supports are transmitted directly with the minimum user of materials.

The end coach normally rests on the end four wheeled bogies by means of a centre-plate and lateral slides. The intermediate units also rest on four wheeled bogies by the same means, whilst the centre coaches rest on spherical centre-plates fastened to the end beam of the intermediate unit.

out horns, so that it is completely free from wear.

To be able to absorb elastically to a great extent even shocks of some magnitude, on each coiled axle spring there is a rubber shock absorber ring, which prevents any sudden limitation of the movement of the spring horizontally as well as vertically. In order to assure longitudinal and transversal mobility of the axle should the spring break or any damage occur to the guiding of the axles, an emergency guiding gudgeon has been provided in each axle box, which is guided in every direction in the bogie sill.

The H shaped bogie frame consists of



Fig. 3. — View of four wheeled bogie without guard plates

The four wheeled bogies, without axle box guides, of the half rake are identical as regards their main dimensions and components, and merely differ as regards the installation of the lighting dynamos and the constitution of the brake gear (fig. 3).

The middle bogies, which has a wheel-base of 2 500 mm — as we have already said — is of the type without axle guards, calculated for an axle load of 20 t. Its actual weight is 5 600 kg. Owing to the restrictions imposed by the coach body, the bogie is designed without end cross piece and without centre balance bar. The wheels have a diameter of 950 mm running circle and are mounted on roller bearings which can be fitted as desired into moulded or welded steel boxes. The guiding of the axles is assured by four coiled springs with-

a welded whole for which ST. 52 steel has been used. In order to obtain transversal rigidity for the frame, the sills and main cross pieces have been made as caisson beams.

The bogie bolster, which is also a caisson beam in ST. 52 steel rests on four sets of coiled springs, each consisting of two springs. The support of the springs oscillates in the bogie frame to which it is fixed by means of a suspension with double adjustable yokes. To guarantee the uniformity of the oscillations of the spring supports, they are connected together by a transversal spring leaf. The longitudinal and transversal play of the bolster is limited by means of suitable rubber components. The damping out of the coiled springs is obtained by means of a hydraulic shock

absorber inclined at 30° to the vertical and inserted between the fold of the springs and the frame on each side of the bogie. The total flexibility is so calculated as to obtain very stable running. The lateral slides arranged on the bolster can be regulated in height which makes it easy to adjust the play between the slides.

The compressed air brake equipment is housed on the bogie and in the body of the intermediate unit. Owing to lack of space, the regulating device for the auto-

bogies. The tare of this bogie amounts to 6 000 kg.

The bogie without axle box guides of the buffet-car is made in exactly the same way as the bogies of the end coaches. The only difference is that one of the lighting dynamos is mounted on the end cross piece turned towards the ends of the rake.

The self contained buffers and screwed couplings at the end of the rake are of the standard type. As for the brake, this is a Hik apparatus for speeds of 120 km



Fig. 4. — Intermediate unit.

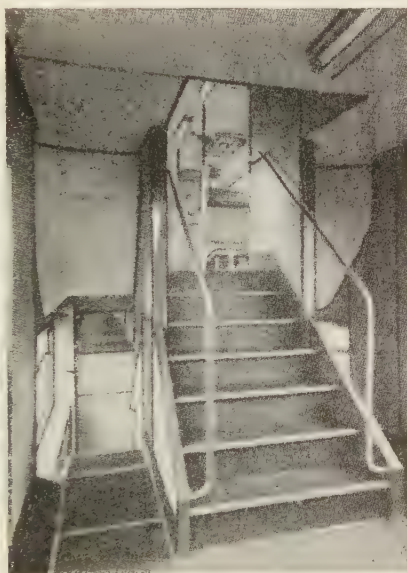


Fig. 5. — Stairway leading to upper deck.

matic braking of the load has been fitted on the bogie bolster. All the brake levers are of ST.52 steel. The brake shoes are of the welded type.

From the point of view of materials and design, the end bogies are made in the same way as the centre bogies described above. The only difference is that these bogies each have an end cross piece which is needed to take the two suspensions of the lighting dynamos. Their total flexibility is about the same as that of the centre

(75 miles)/h and includes automatic braking of the load.

The entry doors are arranged in the end coaches and in the intermediate units; they are wide double doors made of light metal assuring easy access for the passengers (fig. 5).

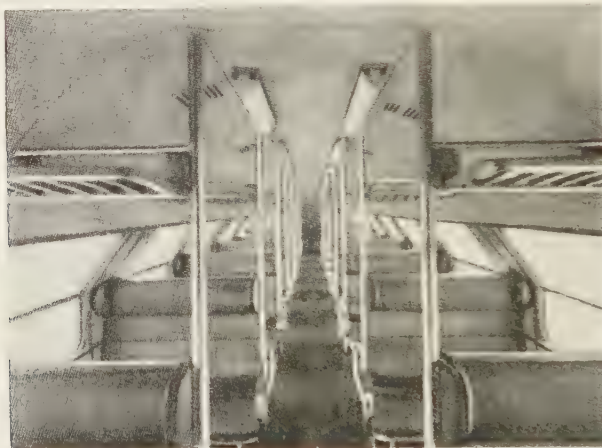
The steps come very low down so that it is easy for passengers to get in and out, even when the platform is at a low level. From the intermediate units, a central stairway leads to the upper deck and two

side stairways to the lower deck of the adjacent centre coaches (fig. 5).

Above the ceiling of the intermediate units, which has only one deck, are the tanks for the toilets, as well as the stabilisers which are scissor shaped and assure the compensation of the obliquity of the neighbouring coaches when the load is unbalanced or at rail joints. In the ridge of the roof of the intermediate unit are the elastic recall devices which are guided in the roof of the centre coach and prevent lateral tilting or different transversal movements of adjoining coaches.

user of the articulated rake, the floors and sides have not been insulated. Only the roof of the upper deck has been fitted with Piatherm, an insulating material made of a type of foam.

In designing the interior arrangement, unlike what has been done previously, new paths have been explored, not only as regards shapes but also as regards colours. The following materials and shades have been used in the passenger compartments: the floor is covered with a coral red linoleum. The sides to window level are covered with salmon pink Igelit and above



Figs. 6 and 7. — Interior of the coaches.

Fig. 6. — Upper deck.

2. Interior arrangement.

There is a total of 128 seats in the upper and lower compartments. These are large compartments lit by 1 200 mm wide windows which assure good visibility. For the interior decoration of the walls, the covering of the sides and floor, specially designed economic panels and wood fibre panels as well as plywood panels have been used. In the same way, for the upholstery materials, designs have been adopted which assure that the material is utilised in the optimum way. In view of the expected

this level, between the windows with zinc yellow imitation leather. The ceiling has been painted ivory. The seats are upholstered in strawberry red, which is not only cheerful for the passengers, but makes the colour scheme harmonious (fig. 6 and 7).

In the old double decker coaches, five passengers sat across the coach. In the new articulated rake, the same length of seat accommodates only four passengers, which considerably increases the comfort.

The seats of the double type are of a new design, with a high back and head

support. For the frames of the seats as well as their framework, light metal has been extensively used. The elastic upholstery is of foam rubber and the covering of imitation leather.

On both upper and lower decks, light metal transversal luggage racks have been fitted which harmonise very well with the decorative scheme. To increase the space available for luggage, cases can be stowed under the seats.

The windows of the lower deck have a fixed lower part without a light metal frame, whilst the upper portions can open

partments also includes ashtrays for each person, coat hangers on the luggage racks and receptacles for rubbish. All the metal fittings are made of light alloy polished and anodised.

Ventilation is assured by ventilators in the ceiling of the upper deck. They are arranged to harmonise with the flat loud speakers.

The connections from the intermediate unit (entrance vestibules) to the centre coach are covered in from floor level by a telescopic device which takes up all the movements of the two adjoining coaches



Fig. 7. — Lower deck.

inwards. On the upper deck, the bottom half of the window slides down by means of a level, whilst the upper half, in the slope of the roof is fixed. The two halves are made without a frame, and for the upper half, in the slope of the roof, a special glass which absorbs the rays of the sun has been used.

In each centre coach, on the lower deck, there are two toilets with a water closet, and wash basin, etc. Access is by means of a swing door in front of the sliding door of the lower deck compartment.

The equipment of the passenger com-

in all positions on curves. The tightness of this connection is obtained by a rubber carpet.

Inside as outside, the connections between the coaches are covered by bands of elastic rubber along both walls and ceiling, (fig. 4) arranged level with the walls and toning in with the colour of the corresponding wall.

Access to the buffet-car is in the end of the last coach. A stairway along the end which reaches about the level of the upper deck makes it possible to reach the sliding door in the wall and thus get into

the buffet-car. The connection between the end coach and the buffet-car is covered in with rubber flanges. The gangway is mounted on elastic supports and when it is coupled up, the coach rests against the similar device on the buffet-car. The gangway and its protective covering therefore require no attention when uncoupling the coaches.

The lighting of the coach in the passenger compartments and entrances is by fluorescent tubes arranged along the ceiling, and give a good light everywhere. The toilets are fitted with the usual type of lighting by incandescent lamps.

To supply the current, each half rake has four Dpl type 24 V. dynamos, which light the half rake when the buffet-car is not attached. The dynamos are arranged, as we have already said, in pairs on the leading cross pieces of the outer bogies, and feed the nickel-cadmium batteries fitted at the ends of the rake. The 220 V A.C. current needed for the fluorescent tubes is supplied by means of converters fitted in the coach. All the electrical equipment is housed in the end wall of the end coach, to the right and left of the stairway to the door. The distribution boards, regulators, batteries and converters are housed in suitable cupboards. Points are provided in the passenger compartments to enable the electric cleaning equipment to be connected up. On the end walls of the end coaches, there are points for connecting up to an outside source of supply. There is another supply for the whole train in the buffet-car, in the form of a 16 kVa Diesel electric generator supplying 180 V A.C. When the buffet-car is attached to the train, this generator supplies all the current used throughout the train.

The loud-speaker installations in the ceilings of the coaches are used to entertain the passengers and to give out important announcements.

A low pressure steam heating installation has been fitted to heat the whole of the articulated rake of 11 coaches. All the radiators and steam pipes in the passenger

compartments of the half rakes are made of light metal tubes. The end coaches are fitted with the standard type of articulated metal connections for the steam, whilst the connecting up of the steam pipes between the other coaches is assured by a specially designed coupling.

The first articulated double decker rake (5 coach unit) is completed; it is now undergoing trials before being put into service.

3. The buffet-car.

The buffet-car is on the point of being completed and will later on be the subject of a detailed description. For the moment, we will merely say that this coach, or even two of them, can be included in a train consisting of two half rakes for long distance services.

The general arrangement of this coach is derived from the design of the articulated rake to the extent that it was possible to apply the same principles for this type of vehicle. For the loading gauge of the coach, gauge II has also been adopted, according to appendix F of the Construction and Operating Regulations. The outside form of this coach, as well as its size, design and window arrangement harmonise with the articulated rake.

Access to the upper deck of this coach from the side is only provided for the staff and for this purpose there are two swing doors placed diagonally at the ends.

On the upper deck of the coach, there is a buffet at each end with all the most modern gastronomical equipment. Between these buffets, there is a dining room with tables and tip up seats. The meals and refreshments are served by waiters who serve each one at his seat. It goes without saying that the passenger can also fetch anything he wants; here again, he can then use a table in the dining room.

The arrangement of this coach, especially on the upper deck, has also followed new trends which take the dynamics of colours into account. The lighting and heating are designed on similar lines to those of the articulated rake.

The lower deck of the buffet-car is used essentially to accommodate the auxiliaries of the restaurant service. At the ends of the coach, immediately above the bogies are two compartments accessible both from the upper deck and the exterior, intended to store the food. These compartments can be refrigerated mechanically or heated.

In these compartments are housed two batteries of accumulators accessible from the exterior which are charged by two dynamos mounted on the bogies. One of these dynamos supplies the current for a radio installation, whilst the other assures the lighting when the Diesel-electric generator is not working.

The lower deck between the bogies has a double swing door on each side opening inwards, in the middle of the coach. From this access, which is reserved for the staff, the engine compartment is reached on one side, in which the Diesel-electric generator is housed. On the other side is the radio compartment and then the pantry for servicing the restaurant-car. This latter compartment is fitted with all the latest equipment required for a kitchen of this size. The conveyance of the meals and plate and dishes to the upper deck is by hand-operated lift.

4. Comparison with other types of coaches.

Trials carried out to date with the articulated rake of five units have confirmed not only that the problem of weight reduction has been solved, but that all the other arrangements meet requirements for the service required of the rake.

The success obtained as regards weight reduction must be classified as very considerable, even taking into account the fact that double decker vehicles have a favourable dead weight per seat, owing to the presence of very high stress bearing sections. This objective has been attained essentially because of the fact that the sections which transmit the thrust of the buffers have been placed at the extreme

limit. In this way, we have obtained very high moments of inertia to carry the vertical load with the minimum amount of materials. The thin side walls which result have been strengthened against shearing movements and deflections by the addition of transversal stiffeners, so that the total section of the coach can be considered as a stress carrying tube.

The actual constructional weight obtained with this arrangement amounts to 6 900 kg in the case of the centre coach and 11 000 kg in the case of the end coach. The weight of the completed coach is 14 200 kg in the case of the centre coach which can seat 128 passengers, whilst the end coach with the same capacity has a tare of 19 200 kg. With these coach weights, the complete half rake has a tare of 129 t. The weight per seat therefore is $129\,000/640 = 201.5$ kg.

If this rake is compared with the four unit double decker rakes, it will be seen that the saving in weight amounts to more than 30 %. The tare of the four unit double decker of the old type was 130 t with 444 seats. In this connection, it must also be remembered that the 5 unit articulated rake is more convenient and comfortable. For example, as we have already said, there are now 4 seats across the coach instead of 5, and there are two toilets in each centre coach with an ample water supply.

The absolute saving in weight, and therefore in materials, compared with the ordinary coaches is very important and is brought out by the following comparison: a C4üp coach of the pre-war type with wooden seats weighs about 35 000 kg with a maximum of 80 seats. To make up a rake to accommodate 640 passengers with these C4üp coaches, eight would be required. This would give a weight for the rake of $8 \times 35 = 280$ t whereas the weight of the articulated rake of 5 units is only 129 t. The absolute saving in the load hauled is therefore more than 150 t, i.e. more than 50 % compared with coaches of similar type. It is obvious that the reduction in the standard of consumption

of materials for these vehicles represents a still higher percentage than is indicated by the absolute saving in the tare, without the convenience and comfort of the passengers being in any way diminished.

With the completion of this evolution, we now have in the German Democratic Republic not only coaches of light weight construction with a very reduced tare, assuring more economic working, but also a new

unit suitable for many uses and in many combinations.

The knowledge acquired with this design, which has been subjected to load tests before being put into service, already makes it possible for us to apply it in new designs for other types of vehicles, not only single deck vehicles but also other types of double deckers, for example sleeping-cars and restaurant-cars.

Experiments with television at a level crossing,

by Dr.-Ing. Heinz WEIDLICH.

(*Signal und Draht*, No. 8, August 1957).

The television apparatus used by the German Federal Railways for outdoors observations have to have completely automatic regulation of the light. This not only simplifies considerably the service of the installation but appreciably increases the useful life of the analyser valves as there is the optimum adaptation to the light conditions of the moment. Some German firms are already fitting their telecameras with this type of regulation.

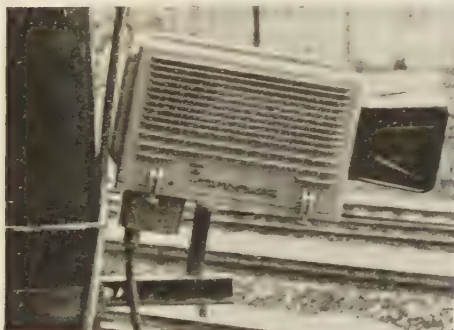


Fig. 1. — Camera with protective box.

The first trials of installations with automatic regulation were made at level crossings. These are an interesting application owing to the fact that their lighting can be achieved at night by relatively simple means.

At the Solnhofen level crossing (Munich region of the Federal Railway Management) a trial has been in hand for some time with an installation manufactured by the firm of Grundig. This installation consists of two cameras, placed in a protective case to shield them from the weather (fig. 1), each mounted on a post near the

crossing (fig. 2). Their lens have a focal length of 25 mm and consequently a horizontal image angle of 23°. Their relative opening is 1 : 1.5. The sites of the posts have been selected so that each camera covers the whole of the crossing and the camera on the other side of it, as well as part of the road up to the crossing. With this arrangement, it is possible to cover if need be the whole of the level crossing with one camera if the second one should fail. Each camera is connected to a control post by a cable. For the trials, the cable to the camera was given a length of 400 m, which is the maximum possible for such an installation. This length was only adopted for the requirements of the trial; for the local position, a length of about 50 m would be sufficient.

The two control equipments are housed in the crossing keeper's office at switch point No. 1. Each apparatus has an amplifier, and a generator set supplying the control equipment and the corresponding camera; this produces in addition the necessary deviation voltage. In addition, each control apparatus is fitted with a high frequency modulator, so that at the outlet of the equipment there is the complete mixture (signals for the image and synchronisation) taken into the band I. The two exits from the control apparatus are connected through a high frequency separator to which is attached the high frequency cable leading to the receiver.

Two distributing cabinets make it possible to regulate the current to the group, the voltage on the plates and the electric setting of each camera. A cutout placed on the cabinet allows the automatic regulation of the voltage plate to be put in and out of circuit. The cabinets are each connected to the control apparatus by a

5 m long cable. As it was hoped to do without any regulation of the setting by the operating staff, by using automatic regulation of the voltage plate, the cabinets

separator in the crossing keeper's office.

The high frequency separator of post 1 is connected to the high frequency separator of the two receivers fitted in the



Fig. 2. — Solnhofen level crossing.

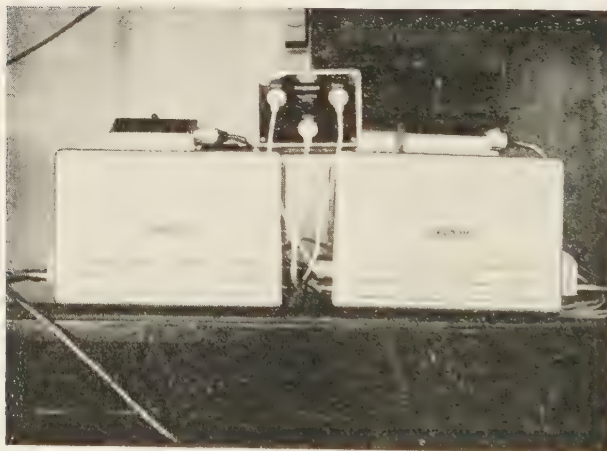


Fig. 3. — Control apparatus, service case, the HF separator.

have been put close to the control apparatus. Figure 3 shows the experimental arrangement of the two control apparatus, the supply cabinets and the high frequency

passenger building at the station by a high frequency cable 1 000 m long. This is the maximum length of cable admissible for transmission without amplification with

this installation; it was adopted in this case for the requirements of the trials. A 350 m long HF cable would suffice for normal transmission. The type of cable used has resulted, with 68 MHz and a



Fig. 4. — Photograph of image appearing on the screen.

length of 10 000 m, in a damping out of about 5 Nepers, so that at the entry to the receiver there is still sufficient HF power to give a clear image. The HF separator separates the frequency of the television 2 and 4 channels, so that each receiver only receives the mixture of frequencies of the camera corresponding to it.

The two receivers in the passenger building have a device to regulate the brilliance of the image, vertical and horizontal control, as well as a device to regulate the contrast. They have a 17 cm diagonal screen. Each screen shows the whole of the image transmitted by the corresponding camera. Figures 4 and 5 show some direct photos from the screen, with the barrier open and the barrier being closed. These were taken by daylight (about 500 lux). For observation at night with the lenses used, still not adequate.

Trials have shown that the number of 300 lines of exploration were quite sufficient for observation in service. It was found however that the automatic regulation of the plate voltage of the analyser valves was not by itself sufficient for the use of the Deutsche Bundesbahn, because

light values of 100 000 lux have been measured. Taking it that the lower limit is 2 lux (in practice, much lower values are found) it must be possible to ensure regulation between 2 and 100 000 lux. If, as during the trials, the regulation of the cut-off remains constant excessive openings of the cut-off occur and under bright lights excitation peaks which it is impossible to reduce by lowering the plate voltage alone. This not only produces a useless image, but also cuts down the useful life of the analyser valves. This (500 hours of working guaranteed) is already very low and must on no account be reduced on any pretext whatsoever or the cost of operation will be greatly increased. On the other hand, with too small openings of the cut-off, the lighting of the level crossing becomes insufficient for observation at night using two 500 W lamps.

Trials of the installation which in its present state is already very usable for operating requirements (weather resistant, only requiring very limited servicing, etc.)



Fig. 5. — Photograph of image appearing on the screen.

will be continued after adding to the automatic regulation of the voltage plate automatic regulation of the cut-off and improving the lighting at the level crossing.

Everything leads us to think, however, that with Vidicon television installations,

it is not possible to observe poorly lighted working operations, such as marshalling yards at night.

For this purpose, it would appear that Orthicon installations are the only ones suitable at the present time. Trials of an Orthicon-Image industrial installation by the « Fernseh-GmbH » carried out at the central goods yard of Frankfurt-on-Main gave surprising results. Such installations make it possible, at night for example, to read the marks and numbers of the wagons

when the human eye can no longer see them. Lighting values below 0.5 lux (relative opening of the lens 1 : 2) made it possible to obtain images that were still usable for operating requirements, so that the current lighting on the Deutsche Bundesbahn is perfectly adequate. However, these installations themselves cannot be used in practice unless they include completely automatic regulation of the brightness, a point which is still being studied by « Fernseh-GmbH » at the request of the D.B.

An innovation in Switzerland. Level crossings with automatic half-barriers.

(*Les Transports Publics*, No. 8, August 1957.)

As an experiment half-barriers were installed on the 17th July 1957 at two level crossings — the first such in Switzerland — which till then had had automatic signals with winking lights. These crossings are those at Fenalet on the St. Gingolph-Le Bouveret road and at La Porte du Scex on the Le Bouveret and Vouvry-Villeneuve road. The C.F.F. intend to

countries, international measures have been taken.

The automatic installation with winking lights and half-barriers works in the following way: at least 25 seconds before the arrival of a train, the winking lights and warning bell begin to work automatically and give the road user a signal to stop. Whilst the present installations have three



Fig. 1.

install this new signalling at 6 level crossings to begin with. By doing so, they will be participating in trials according to a programme laid down by the International Railway Union (I.R.U.) in which France, Germany, Austria, Italy, Luxemburg, Holland, Denmark, Norway and Yugoslavia are also taking part. To make sure that all these installations will work as far as possible in the same way in all these different

lights which light up at the same time, these new installations only have two, placed side by side which show a red winking light in turn. After about 7 seconds, the barriers begin to come down. This lapse of time is sufficient to give road users time to get out of the danger zone. The closing of the level crossing takes about 12 seconds. When they are down the half-barriers only shut off the right hand side of the road, so that no one suffers any risk of getting



(Photos Roland Schenkel, Lausanne.)

Fig. 2. — The excellent signalling of the new level crossing at La Porte du Scex.

trapped inside them; it is always possible to get out of them.

For everything to be in order, it is necessary for the road to have two distinct carriage ways. The middle is marked by a white line. Consequently, it is not permissible to overtake another vehicle in the neighbourhood of the barriers nor to pass beside them when they are down. The half-barriers are fitted with oblique red and white bands: the red bands are made of reflecting material. Red lights are permanently alight at the end of the barrier pole. After the train has passed, it takes about 10 seconds for the barrier to lift up and then the winking lights go out.

The aim with these new installations is to make them as visible as possible to road users, so there is also a red and white enclosure around the motor operating the half-barriers. For the time being, the signals that are already used at level crossings without keepers will be kept as distant signals.

There can be complete confidence in the working of the automatic installations with winking lights, an opportune method of assuring safety at level crossings which will then remain closed for the minimum of time.

But it is also necessary for road users to observe the signals and never try to pass over the white line marking the middle of the road. The C.F.F. hope by means of these new installations, used in special cases, to prevent accidents at level crossings and they are counting upon the discipline of road users.

Rail-mounted viaduct inspection unit.

Direct access to underside of viaduct arches or high bridges.

(The Railway Gazette, November 15 and 22, 1957.)

The hydraulically operated rail-mounted viaduct inspection unit developed and put into service by the North Eastern Region or British Railways, is believed to be the first of its kind in the world.

a depth of 29 ft. below rail level and to travel under the arch a distance of 15 ft. from the outside face.

The unit is in three main parts, these being an A frame with a slewing gantry



Inspection unit with upper boom vertical and platform below bridge.

The equipment is mounted on a bogie bolster type wagon 52 ft. over headstocks, 3 ft. 10 1/2 in. rail to floor level and 7 ft. 9 in. wide. It is designed to give direct access to the underside of viaduct arches or high bridges, with a payload on the inspection platform of 600 lb. It is possible to carry out inspections to

and an upper and lower boom. In the centre of the A frame there is a gate type hinge mounting with 2 1/2 in. dia. bearings for the slewing gantry which is a triangular cantilever frame construction 12 ft. 6 in. long carrying an operator platform 2 ft. wide on each side of the main frame to give access to the inspection

platform and the duplicate control levers. The slewing motions of the gantry are controlled from the gantry platform by a lever operating a valve control to a 5 in. dia. hydraulic ram with a 36 in. stroke.

Hydraulic ram.

The ram has two operating positions and is permanently fixed at one end to the gantry and can be locked at the other end in either of two positions by a removable pin fitted with a safety lock to the channel base frame unit carrying the A frame. The operation of the ram rotates the gantry and booms over the viaduct or bridge parapet wall, through 90 deg. to either side of the centre line of the wagon. The gantry is designed to clear a parapet wall 4 ft. 6 in. above rail level by a margin of seven in. On the free end of the slewing gantry there is a 2 1/4 in. dia. horizontal shaft for the boom mountings. Two double-acting control valve levers are mounted alongside the slewing control valve lever on the gantry platform to operate the upper and lower motions to each boom. All boom control valves are of the four-way open centre spool type arranged for simultaneous operation, allowing the valves to be used singly or together when simultaneous action of different movements is required.

The upper and lower booms are of box section, formed from light gauge steel pressings with welded bulkheads to give rigidity. The upper boom is 21 ft. centre to centre of pivot points with one end connected to the horizontal shaft on the gantry unit and the other carrying the lower boom which is 17 ft. long. The movements of the upper boom from a horizontal position through 85 deg. in a downward direction are controlled by a 6-in. dia. hydraulic ram with a 36-in. stroke mounted on top of the triangular gantry frame. The movements of the lower boom are controlled by a 6-in. dia. x 36-in. stroke, hydraulic ram mounted

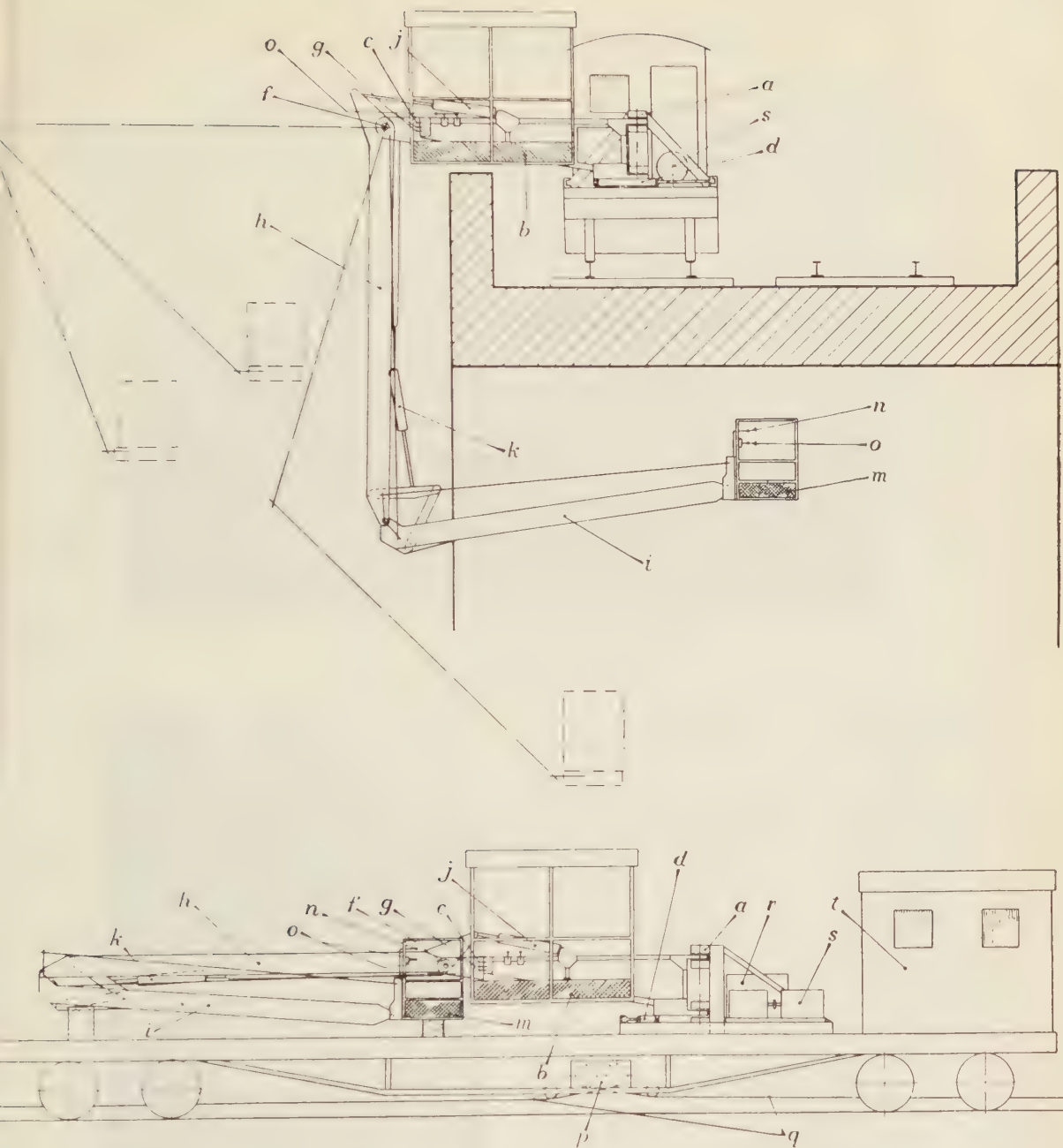
underneath the upper boom. When the upper boom is in the near vertical position, down the side of the viaduct, the lower boom can travel 30 deg. above or 60 deg. below the horizontal.

On the free end of the lower boom is mounted the examiners' inspection platform, 7 ft. long x 2 ft. 10 in. wide, capable of carrying a payload of 600 lb. A simple parallelogram system of tubular levelling rods attached to the platform and running along the booms but separately fixed at the pivot points, ensures that the inspection platform is maintained in the horizontal position.

Remote operating controls are fitted on the inspection platform to allow the occupants to control the movements of the booms within prescribed limits fixed by mechanical stops which bring the control valves into the neutral position, so stopping the flow of oil to the cylinders. A remote control is also fitted on the inspection platform to operate the special type of hydraulically driven bollard winch fitted to the underframe of the rail wagon.

Power unit.

The main power unit is a Petter AVA2 twin-cylinder four-stroke air-cooled diesel engine fitted with electric starting equipment and driving three hydraulic pumps. One of these pumps, delivering 2 1/4 gal. per min. at 1000 lb. per sq. in., provides power to the rams operating the slewing movements and the booms. The other two pumps, both delivering 5 gal. per min. at 1200 lb. per sq. in., provide power for the winch. The power unit is fixed to the channel base frame in rear of the A frame mounting and incorporates a diesel fuel tank and hydraulic oil reservoir. The base frame is secured to the wagon frame by 1-in. dia. U bolts. A Hamworthy pressure compensated control valve is fitted in the slewing and boom circuits and is pre-set for the most suitable speed of operation. This regulates the amount of oil passing to the control valves at the



a. « A » frame;
 b. Slewing gantry;
 c. Slewing gantry valve control;
 d. Slewing gantry hydraulic ram;
 f. Boom mounting shaft;
 g. Boom control valve levers;

h. Upper boom;
 i. Lower boom;
 j. Upper boom hydraulic ram;
 k. Lower boom hydraulic ram;
 m. Inspection platform;
 n. Remote operating controls;

o. Winch remote control;
 p. Bollard winch;
 q. Winch rope;
 r. Power unit;
 s. Generator;
 t. Cab.

(Above) cross section end elevation viaduct, showing inspection platform in working position;
 (below) side elevation of unit with booms stowed.



Inspection unit on Knaresborough Viaduct, North Eastern Region, with the twin booms stowed on bogie bolster wagon.

free end of the slewing gantry; the surplus oil is by-passed back into the reservoir.

Special efforts have been made to cover the possibility of breakdown and these include the duplication of all hydraulic controls, and the fitting of hydrolocs on both boom circuits so that in the unlikely event of a hydraulic pipe failure the oil flow is locked and the booms can still be controlled. There are two hydrolocs or pilot operated check valves fitted to the upper boom control cylinder and a single hydroloc on the lower boom cylinder. These prevent oil leaving the cylinder until pressure is applied to the opposite end of the cylinder. When locked, the booms cannot move downwards under gravity. In the event of engine failure, a hand control can be fitted to the pump supplying power to the boom rams.

The bank of control valves includes a relief valve which limits the boom circuit pump pressure to 1 000 lb. per sq. in. and also a secondary relief valve set on 250 lb.



Inspection platform in position below viaduct arch.

per sq. in. The secondary valve limits the pressure in the 5-in. dia. slewing cylinder and prevents damage to the machine due to accidental operation of the slew control valve when the machine is in the travelling position on the wagon. Double levelling rods are fitted, each capable of keeping the inspection platform level.

A 3-kW D.C. generator operating on 110 V and driven by a Petter AVA1 diesel engine is also fitted to the channel frame in the rear of the A frame. This generator provides power for lighting and electric tools. Two 300 W flood-lights are fitted on the inspection platform. Spot-lights of 150 W are fitted to each end of the rail wagon above headstocks.

Communication between the cab and the men on the inspection platform is provided by two field telephones. A push button is fitted on the inspection platform to operate a 12-V klaxon on the slewing gantry.

The development of this unit has been carried out under the direction of Mr. A. Dean, Chief Civil Engineer, North Eastern Region. Construction of the A frame, slewing gantry and the two booms was carried out by Simon Engineering (Midlands) Limited, of Dudley, Worcestershire; the special winch gear and cab were constructed and fitted by the Auto-Mower Engineering Co. Ltd., of Norton St Philip, near Bath; and the lighting generator was manufactured by Auto Diesels Limited, Uxbridge, Middlesex.

Wayside detectors enhance safety.

(From the *Railway Age*, November, 25, 1957.)

Ten forms of automatic apparatus, installed at many places on the road and in yards can automatically detect hazardous conditions of tracks and bridges as well as defects on passing cars and locomotives, and can control signals to stop trains. From now on there will be an increasing need for these automatic safety detectors, not only because these devices are much more effective than previous practices of depending on train crews and men working along the right-of-way to see the defects, but also because fewer men are working on the wayside.

Railroads are having difficulty in finding enough competent telegraph operators willing to work at outlying points. Interlockings at crossings of railroads at outlying locations are being converted from manual to automatic control, or are being included in centralized traffic control projects. Automatic electric crossing gates are being installed at numerous crossings to replace watchmen and gatemen at manual gates. Many offices previously open 16 to 24 h daily have been abandoned.

Furthermore, on many roads, new forms of power machines are being used to do practically all of the track maintenance work. Spot maintenance is done by small crews covering sections of 30 miles or more. On numerous roads, these long-range track crews use highway trucks rather than track motor cars.

This means that the number of operators, levermen and track men working on the wayside on most railroads has decreased decidedly in recent years, and will decrease further. As one consequence, there is a definite need for extensive applications of automatic devices that will detect hazardous conditions on tracks and bridges, as well as defects on trains.

Conventional automatic block signaling, in addition to indicating track occupancy, includes safety checks for (1) broken rail, (2) normal-closed position of all main track switches, and (3) cars occupying turnouts short of the clearance point. In addition, there are 10 more forms of auto-

matic safety detectors which have definitely proved their worth in railroad service for periods ranging from one year to 25 years or more.

Devices are available for detecting :

- Hot boxes.
- Dragging equipment.
- Flash-floods and high water.
- Broken car wheels.
- Wheels loose on axle.
- Fire on trestles and bridge decks.
- Exact alinement of bridge piers.
- Earthquake tremors.
- Rocks falling on tracks.
- Dirt slides and snow slides.
- Falling snow and ice.

For dragging equipment.

Brake beams or other loose equipment when hanging or dragging from cars or locomotives may cause derailments. About 22 years ago, devices were developed to detect such defects. One type consists of a long loop of brittle cast-iron, mounted on both sides of each rail, just below standard clearance for rolling stock. Hanging parts will break one of the detector loops which are so connected in a circuit that a relay is released.

Another type of dragging-equipment detector consists of sheet-metal panels bolted to a horizontal shaft mounted on bearings between two track ties, so that

the top edge of the panels is about level with the top of the rails. When dragging equipment strikes one of the panels, the shaft is rotated a few degrees, operating



One type of dragging equipment detector consists of cast iron brackets.



Other type has sheet metal panels on a horizontal shaft between two track ties.

a circuit controller. Then spring pressure returns the panel to normal position.

Dragging equipment is most likely to cause derailments at switches where turn-

out rails may deflect the loose parts under the wheels. Therefore detectors are placed in approach to interlockings which include numerous switches and crossovers, as well as at important bridges and tunnels where a derailment might cause serious damage and perhaps block the line.

A total of more than 800 sets of these detectors have been installed on the lines of such railroads as the B & LE, B & M, DL & W, CGW, CMStP & P, GN, GM & O, NYC, MP, PRR, SP, SP & S, T & NO, UP and Wabash. Some of these roads, and others, have installed these detectors as part of car inspection facilities on the track approaching the hump in gravity classification yards.



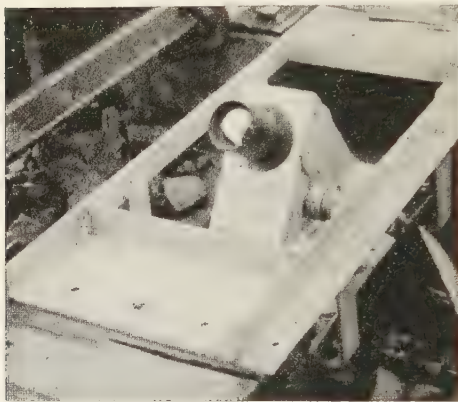
Device to detect falling rocks is made of wire fencing.

For broken wheels.

Freight car wheels with sections of the flange broken out have caused serious derailments. Such defects are difficult to find, even when a car is standing in a yard. A device that automatically detects broken wheel flanges, as well as wheels that are loose on the axle, while cars are in motion, has gone through several years of development.

Each detector consists of a series of spring steel fingers, at right angles to the

rail, with an insulated hardened steel pad near the end of each finger. The upturned end of each finger extends $\frac{3}{4}$ in. above the top of rail. The flange of a normal wheel encounters the insulated pads, thus



Infrared ray hot-box detector, located alongside the rail, checks all boxes on passing train (view without cover).

depressing the upturned fingers away from the tread of the wheel. If a section of flange is broken out, the contacting finger tips touch the tread and cause a relay to operate.

This device will also detect a loose wheel if it fails to stay on the insulated pad. Each detector is 11 ft. 6 in. long, i.e., more than the circumference of a 42-in. wheel. The detector functions at train speeds up to 20 mph. When a defective wheel is detected, an automatic pump sprays yellow paint on it, and an alarm is sounded.

These detectors have been installed on the D & RGW at Grand Junction, Colo.; RF & P at Potomac Yard, Va.; C & O at Covington, Ky.; NP at Pasco, Wash.; Southern at Birmingham, Ala.; and ACL at Florence, S. C. Detectors have been shipped for installation on the B & M at Mechanicville, N. Y., and B & O at Cumberland, Md.

Six months after the device was in-

stalled on the RF & P it detected a wheel with a 14-in. section of the flange missing; and the next day it detected a wheel with a 12-in. section gone. In about four years service on the D & RGW, the device detected ten wheels with broken flanges, one wheel loose on the axle, and one false flange. The NP installation placed in service September 5, already has detected one wheel with 8 in. of flange gone, a second with 10 in.; and a third with 3 in. gone and with a 36-in. crack in the flange.

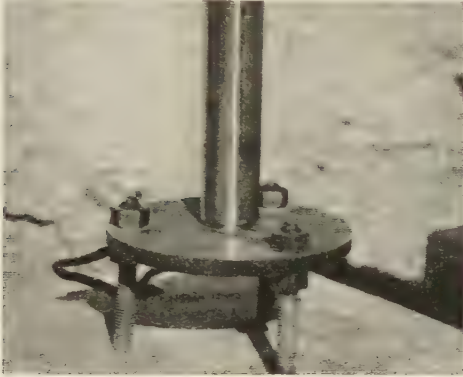
These installations listed are at yards where speeds are slow. However, there is no reason why this detector cannot be installed on line of road at junctions, or other places where speed restrictions up to 20 mph are in effect. The detector can be damaged by equipment that is hanging or dragging from cars or locomotives. Therefore, a logical practice is to install dragging-equipment detectors in approach to the broken-wheel detectors. Considering the increased safety achieved by these broken-wheel detectors at a comparatively small cost, more extensive use on more roads can be expected.

For hot boxes.

The newest member of the detector family, the infrared ray electronic hot-box detector, described in the April 1 Railway Age, has proved to be an effective and economical means for detecting hot boxes on passing trains. These devices have been in service for 6 months to a year on the C & O, B & M, N & W and Reading. Projects completed recently, or now under way, include one each on the DL & W, Reading, N & W, C & O and Pennsylvania, and two each on the NYC and the Southern.

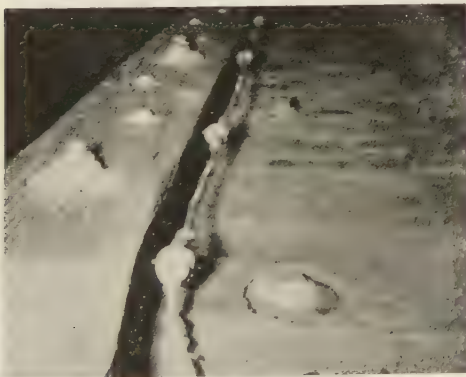
Boxes that are dangerously hot, but not evident to train crews or railroad employees watching from the wayside, are detected by this device. The B & M located the detectors 30 miles out from a terminal so boxes that are going to heat will have time to reach a temperature to

be detected. This B & M project detected 52 hot boxes in five months. In July the C & O installation detected 8 hot boxes, only one of which had been discovered by the train crew or the operators at wayside offices.



A set of 12 devices like this made of pieces of steel shaft ranging to 6 in. long, detect intensity of earth tremors.

Other roads have located detectors to check incoming trains as they enter a yard. During about four months one at the Roanoke, Va., yard entrance on the N & W detected 104 boxes which had ab-



Fire, on wood trestles or bridge decks is detected by this device consisting of heavy wire with lap solder joints.

normal temperatures. Because this detector proved to be so effective, in checking for such conditions, this road looks forward to the practicability of omitting journal inspection of cars coming into the yard.

For floods and high water.

Flood detectors include cork floats which rise with the level of water. By using a long rod from the float up to a controller, this controller can be at a level convenient for inspection. A latch holds the float in the raised position until the signal maintainer or track foreman arrives to check flood conditions.

These flood detectors are installed not only adjacent to bridges and alongside embankments but also at points up stream to detect oncoming rushes of water caused by heavy rainfall in limited areas in hills remote from the railroad. The locations for each detector can be determined from records of rainfall in watershed areas. Some of the roads which use flood detectors are the Santa Fe, SP, Milwaukee, MKT, KCS, CRI & P, MP, T & NO and SP.

For rocks on tracks.

To detect large rocks that roll down hillsides or fall from cliffs onto tracks, fences including circuit controllers are used. Some roads use ordinary stock fencing with wires loosely stapled at intermediate posts but attached at each end of a section to a cross member which in turn is attached to a circuit controller tension in the fencing being maintained by springs. Fences are located near the tracks or up the slope as required. Where rocks fall from cliffs, overhead network fences can be used.

These rock detectors have been installed extensively on numerous railroads, including the D & RGW, MP, N & W, SP, SAL, WP, SP & S, and UP. The Clinchfield installed 24 645 ft. of these detector fences during 1957. In May 1957, one of these

devices on the Missouri Pacific detected a large rock that rolled down and came to rest on the main track. Thus it most certainly prevented a train accident.

At some locations, soft mud slides down from banks onto the track. At such places, some roads use low fences constructed of planks on posts which are jointed at the ground line with sections that break easily. Mercury-level circuit breakers detect any movement of the fence from vertical. A fence to detect snow slides has been used on some roads. When snow pushes against it, a plug is pulled to open a circuit.

For fires.

Fire damage to timber trestles, bridge decks, tunnel linings, and timber snow sheds can result in hazards to trains. Therefore, at such locations several railroads have installed fire detectors.

Typical construction consists of insulated No. 10 copper wire supported on porcelain insulators about 6 ft. apart, with a 2-in. soldered lap joint between each set of insulators. The solder melts at a comparatively low temperature: If a fire melts the solder, the weight of the wire opens the joint, thus opening a circuit to operate a detector relay.

For snow and cold.

A special device, that detects falling snow and rain at freezing temperatures, can be installed at outlying locations to transmit such information to the nearest open office or to the dispatcher.

Also this device meets another need. Not enough track men are available these days to sweep snow from switches at outlying locations. Some roads have installed heaters to melt the snow in switches, and others use motor-driven blowers. These blowers or heaters are controlled by the dispatcher as part of the CTC.

A missing link is that snow heavy enough to block switches may fall at remote locations in CTC territory without

the dispatcher knowing about it. To meet this need, railroads can now utilize the new device that automatically detects precipitation when the ambient temperature drops below 37° F. Snow or ice forming



Pump squirts paint on defective wheel when device detects a break.



Cork float at bottom is raised by flood thus operating a controller at the top, thereby detecting high water.

on the « bowl » (top) of the unit is melted, and thus completes a circuit to a relay which can control the switch heater or blower, as well as send an indication to the dispatcher. When snow or ice ceases to fall on the detector, the circuit is opened, thus turning off the heaters or blowers, and sending an indication to the dispatcher.

For bridge position.

A device which detects fog has been developed recently. The basic principle is that of measuring the amount of light reflected from water particles suspended in the atmosphere. The manufacturer states that the device will detect mist, fog, heavy rain or snow.

some roads have installed detectors. The device includes a heavy pendulum which normally hangs vertically. If it swings off center, it breaks a short strand of fine wire, thus initiating a warning.

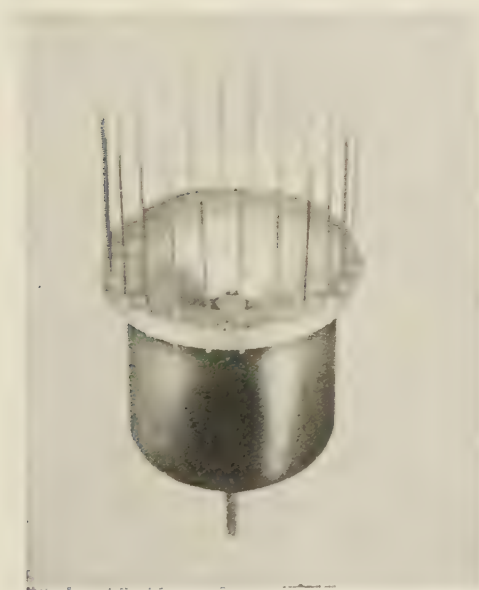
To check the normal position of a girder, a terminal on the end of this girder is connected by a fine wire to a second terminal directly opposite on the face of the masonry of the pier. The wire will be broken if the girder moves away from the pier more than 1 in. in excess of normal contraction. A relative change of horizontal alinement can likewise be checked.

In areas where earth faults are known to have caused earthquake tremors in recent years, one road uses the bridge-position detector as explained above. Although there has been no damage to railroad tracks and structures, in one danger area a means of recording the intensity of tremors, and informing the dispatcher when such tremors occur, seemed desirable. Therefore, signal department forces developed and installed devices that detect 12 different ranges of intensity and transmit information accordingly to the dispatcher.

How detectors control signals.

Having detected a hazardous condition on the track or a defect on a car in a passing train, the next problem is to give this information to the engineer so that he can stop his train. This objective is readily obtained by arranging circuits so that operation of a detector indirectly controls a wayside signal to display an aspect to direct the engineer to stop his train.

In some installations, existing signals at interlockings or in automatic block are used. Where no such signals are available, some roads are using a special flashing-lunar aspect on a wayside mast which indicates « stop train for inspection ». The hot-box or dragging equipment may be on any car in a train, therefore, the detector should be located, in approach to



Falling snow or freezing rain operates this automatic detector. Rods extending up prevent birds from alighting.

Even with the best of construction, some bridge piers in streams may settle out of alinement. This may change the relative position of the end girders and the abutment piers. To check these conditions,

the flashing-lunar signal, a distance equal to the length of the longest train plus approximately 1 000 ft. sighting distance from the locomotive to the signal. The use of such a single signal, with no approach aspect, is based on the fact that the flashing-lunar aspect does not mean that the train must be stopped short of that signal, but rather that the engineman is to stop his train as soon as he can do so with safety, i.e., without applying the brakes in emergency.

Using existing signals.

In connection with devices which detect hazards on tracks and bridges, such as washouts, floods, fire, and falling rocks, the signals that are to be controlled are located to stop trains before arriving at the hazard. In many instances, existing automatic signals can be used.

On the SP each such signal has a special rectangular marker which designates that the control of each signal so marked includes not only the conventional automatic block controls but also special detector devices. If the engineman and conductor do not already know what the devices are, as applying to a signal at which they are stopped, the information is given in the timetable. Then they look for the corresponding rock on the track, washout, etc. Telephones connected to the dispatcher's line are located at these signals so that conductors can advise the dispatcher of the condition.

What to do now.

Need for action in this matter has been brought about by reduction in the number of men who watch for hazardous conditions on railroad tracks and on

passing trains. Opportunity to use any or all of the ten forms of detectors that have proven satisfactory is a further consideration.

With one exception, the detectors are comparatively inexpensive in first cost and maintenance. Roads which up to now have not installed these protective devices can easily make a few trial installations of each type soon, and thus secure information on which to base decisions about extensive programs.

A complete analysis of numerous local circumstances and number of trains is required when planning an extensive program. Locations for falling rock detectors are obvious. Detectors for flash-floods and high water can be located according to watershed area and short-period record rainfall. Dragging-equipment detectors are applicable in approach to all important bridges and tunnels, as well as in approach to junctions or turn-outs 25 to 30 miles apart on medium traffic lines or 10 miles apart on heavy traffic lines.

Hot-box detectors may be located at the entrance to yards, and at points 25 to 30 miles from a departure yard, so that journals which are in condition to heat will have time to get hot in that distance. Experience may indicate more locations. Broken-wheel detectors can be located at entrances to yards and at junctions or other places on line of road where train speeds are restricted to 20 m.p.h.

Installation of these safety devices is not going to accomplish a determinable reduction in operating expenses, such as 25 % or 50 %. No one can figure the expense for an accident that was prevented. On the other hand, practically every road has data on the expense involved in wrecks during years past.

Economics of various types of yard-to-yard car reporting.

(Reprinting from Bulletin 539, November 1957, of the « American Railway Engineering Association ».)

Re-transmission between marshalling yards relating to each individual car has been in operation for many years in the U.S.A. and, more recently, has been adapted to the use of punch cards.

This adaptation is of great interest in relation to subsequent development. This is why a Committee of the A.R.E.A. was set up with a view to report on the various processes which have been found interesting in practice and have been adopted. By courtesy of the A.R.E.A., this report is reproduced hereafter.

Yard-to-yard car reporting is the basic element to be considered in designing a mechanized car reporting and accounting system.

The objectives of such a system normally are :

1. To improve yard efficiency, expedite classification, and advance train departures;
2. To facilitate and improve car distribution and enhance the utilization of all freight train equipment — both power and rolling stock;
3. To minimize, or eliminate, the random tracing of individual cars by automatically providing complete and current « passing reports » to traffic and transportation offices and promptly to advise customers of bad order cars delayed and their probable forwarding.
4. To eliminate manual preparation of train consists, wheel reports, interchange reports, switch lists, on hand reports, etc.;
5. To provide automatic input data for mechanized car accounting procedures;
6. To provide a basis for special traffic analyses.

Railroads for many years have transmitted train consist information by teletype from yard-to-yard. In some cases the consist merely listed the various groups of

cars which made up the train; in other cases, this has been supplemented by each car's initial and number together with its destination or off-going junction. Now on many roads complete detail is provided as to type of car, contents, weight, shipper and/or consignee, routing, etc.

A typical modern system works somewhat as follows :

When a car is received from a connecting line or when a car is tendered to the railroad from an on-line shipper, all data concerning it are manually punched — from the waybill — into business machine cards and verified at the first equipped yard through which it passes. For the great majority of cars, such being the normal concentration of traffic, this would be the yard at the interchange gateway, or the origin city. Two cards are normally required for loaded cars — a movement and a traffic card.

The movement information — the No. 1 Card — usually consists of the car's initial and number, its type, whether loaded or empty, its contents and weight, destination or off-going junction and road to which delivered and the consignee.

The traffic information — the No. 2 Card — repeats for loads the car's initial and number in order that it may be

machine-matched to the Movement Card, and normally supplements the movement data with the waybill date and number, the billing road, the origin city and state, the shipper and the routing.

A third card is sometimes used to cover special instructions, icing or other servicing, reconsignments, etc. Or it might be used to show rates and charges, thus providing complete coverage of all data on the waybill and providing a basis for revenue accounting.

The information on the Movement Card must precede the train handling the car, as it advances from yard to yard. On large roads with substantial volume of traffic, requiring dispatchment of many trains per track from major yards, it has generally been found that manual teletyping of detailed consists direct from the waybills is too slow: it would hold up the trains. The method commonly used to speed up the transmission process is to pre-punch at the first equipped yard the waybill data for each car into business machine cards. The cards are temporarily filed with the corresponding waybill. These cards can subsequently be made into a deck when the train is made up and the waybills are pulled, each card in the deck representing a car in the train and lined up in the same order. A header card is then added showing the train symbol, yard of departure, Diesel unit numbers and date and time of departure. A caboose card completes the deck, showing number of loads and empties, total cars and tonnage. The data and time of departure, and the yard are gang-punched into the header card and into each individual car card. Then by card-to-tape techniques the deck of cards quickly produces a perforated paper tape which in turn actuates the teletype machine immediately following the train's departure. This method has the great advantage that the receiving yard next ahead gets not only a detailed printed consist of the on-coming train, but it also automatically punches out a perforated tape, which can immediately be run through a tape-to-card machine to reproduce a deck

of cards identical to that which originated the cycle.

Beyond the first equipped yard, where manual card punching is required, the punched cards are self-regenerating, and after reshuffling reflecting switching operations, they are automatically transmitted from yard-to-yard. When the train arrives at the yard next ahead, its arrival date and time are gang punched into each card of the deck previously received. (To hold communication load to a minimum, the gang punching can be done at a district bureau or central bureau if these have been established for reasons described hereafter.) A record is thus created for each car, showing every yard and train handling and the time involved. It is available at the yard ahead several hours prior to the train's arrival. The yardmaster, knowing the number of trains and the number of cars en route, together with their various destinations, which must be switched during the next several hours, can line up his power and crews, arrange for icing or other servicing, prepare for diversions or reconsignments, etc. Pre-planned work makes for increased efficiency and economy of operation; it expedites classification and so advances train departures. This is objective 1. In turn, this saves car hours, which accumulate into car days and reduces per diem payments. Advance reporting of train and car movements is an important tool to improved operations — but like any other tool its use must be understood; it must generate confidence and be effectively applied if it is to « pay off ».

If this basic yard-to-yard or movement data on card No. 1 is to serve other than objective 1 outlined above, a means must be provided for concentrating it at transportation and accounting headquarters. Similarly, the traffic data on card No. 2 must also be brought to a processing center.

This can be accomplished by secondary transmission to a central bureau, or on large systems perhaps more economically via district service bureaus. With modern communications' switching systems the secondary transmission is automatic and vir-

tually concurrent. At such concentration points the original No. 1 and No. 2 cards are automatically reproduced and can be used singly and jointly for various purposes.

The Transportation Department, which normally should exercise jurisdiction over the central or district bureaus, can for instance sort the accumulated No. 1 cards from many trains on many divisions and pull out empties, sub-sort them to types of cars and by ownership and then localize their whereabouts. This provides a sound basis for car distribution. It can work from the train's header and caboose cards, which show the Diesel units, cars handled and tonnage to provide a current record of power utilization. This is objective 2.

The No. 1 or Movement Cards each afternoon can be machine-sorted at the bureau to car number sequence, then run through a high-speed accounting machine which prints out movement data for each car — its train and yard handlings — on multilith mats from which a daily passing report may immediately be printed for distribution by mail to all traffic and transportation offices. Or by selective sorting to origin and destination states, the data can be put on tape for teletype transmission to interested traffic offices — if economically justified.

With all cars readily identifiable by car numbers tabulated in sequence, the most recent « passing » can promptly be made available, responsive to customer inquiries. This is objective 3.

Objective 4, like objective 1, is at the yard level. At major yards where volume justifies the use of an accounting machine, local yard records can be compiled as to cars switched, cars on hand, time required to transit the yard, etc. Records of cars which have departed from a yard are very important, but it is also desirable to have a complete record of cars in the yard. Loaded cars off schedule, showing the time they have been detained at the yard, can be developed through selective sorting. It provides a means for expediting their movement and, as to empties, a means to improve car distribution.

When the cards for a departing train have been arranged in train consists order, they can be run through the accounting machine to print up the conductor's wheel report — a 2- or 3-min operation.

When properly arranged, they can print up puller consists, interchange drafts, switch lists, arrival notices, etc.

At yards not large enough to justify an accounting machine, the cards arranged for specific purposes can be run through a card-to-tape machine and the tape then used to print up tabulations on a teletype printer, disconnected from the circuits. This, of course, is a slower method and has its limitations, particularly as to wheel reports.

Objective 5 is to provide automatic input data for mechanized car accounting procedures. Normally these depend on wheel reports or train consists and interchange reports. The No. 1 or Movement Card provides the basic data in a form normally acceptable.

Objective 6 is to provide a basis for special traffic analyses. This requires the No. 2 or Traffic Card, matched by car initial and number, to supplement the data on the No. 1 card. It should as previously noted include the waybill date and number, the billing road, the origin city and the shipper, and also the routing involved. Traffic data can then be developed by selective reproduction of data from the No. 1 and the No. 2 cards to a combined statistical card, then sorting on standard tabulating equipment to origin and destination states and cities, or by shippers and consignees or by commodities. Or the cards, suitably combined, can be used as input material to a computer programmed to develop whatever type of data the Traffic Department may require. In the latter case, such analyses should be the responsibility of the Traffic Department.

It must be understood that the results obtained depend entirely on the accuracy with which the cards are originally prepared at the yard office. Numerical coding, while more precise, is generally too time

consuming and therefore unsatisfactory. Alphabetic punching requires faithful adherence to agreed-upon abbreviations as to junctions and commodities, precise fielding of data and poses a problem as to complicated shipper and receiver names. Alphabetic sorting require more passes through the machine than if numeric.

The success of any mechanized system depends on close cooperation between all departments which contribute to the operation or which rely on information flowing from it. It requires thorough planning and precise procedures set forth in a Manual of Instructions and adequate training for the personnel who will operate it — particularly at yard levels. And most importantly, there must be a determination to make it work and confidence to rely on it as an aid to operating and sales efforts.

The above statement of major objectives — all directed toward improved management controls — and a very brief description of certain ways and means to attain them is not intended to be definitive; it merely points out certain concepts which have been applied to varying degrees and in differing combinations by many roads since World War II.

A road contemplating such an installation should carefully review typical ones already made. Such publications as *Railway Age*, *Railway Signaling & Communications*, *Modern Railroads*, *Proceedings of the Railway Systems and Procedures Association*, etc., provide excellent references.

The decision should be predicated upon an economic study. Because many departments are involved — operating, transportation, communications, freight traffic, accounting — a committee approach has often been used. It has much to recommend it.

These factors must be considered:

System design. — This depends on a railroad's traffic flow pattern and the volume of loaded and empty movement through various gateways or junctions; the primary yards which dominate its operations and the secondary yards which support

them. Detailed car counts must be made and evaluated into train dispatchments; daily and seasonal peaks of traffic must be considered with other factors to provide a basis for an adequate communication network.

Communications network. — The problem here is the ability of a road's own communications system to assume the added burden which will be thrust upon it. To provide adequate capacity at peak periods it may be necessary to superimpose carrier circuits or perhaps even string new lines. The alternative to such capital expenditures and ensuing maintenance is to lease commercial communication circuits and related components. Tax and financial considerations are involved — all must be carefully weighed preliminary to a decision, as large sums of money are involved.

Physical additions and betterment. — Car-reporting systems are essentially based on yard operations. Some yard installations will probably require an up grading or reconstruction of yard offices. Those to be equipped with business machines will frequently require improved lighting, air-conditioning, etc. District or headquarters service bureaus may be costly installations; with modern electronic equipment large quantities of heat are generated, requiring air conditioning.

Business machines required. — These depend on the extent of the system and the objectives toward which it is oriented. At all yard offices there will be teletype equipment, and if communication is to be speeded up at larger yards by mechanized techniques, they will require key punches, card-to-tape and tape-to-card machines. At major yards there should be in addition card sorting machines and accounting machines to print up tabulations, reports, etc.

At the district or headquarters bureaus, to carry out their functions, plans should consider tape-to-card machines, collators, sorters, statistical machines and accounting machines. High-speed printing machines are necessary to print up daily passing and traffic reports; efficient mailing facilities

are also essential to distribute them. This equipment is available on a rental basis or may be purchased. Substantial sums are involved which require detailed planning and programming.

Personnel required — and saved. — Modern mechanized methods and procedures, carried out by a well-trained force working toward objective 4 should lead to savings in personnel at the yard level. It may take some time to bring this about, but local supervision should be pressed to effect economies. Targets should be established with that objective.

The new service bureaus must, of course, be staffed, the number of clerks required necessarily depends on the objectives and the equipment installed.

With a systematized tracing procedure achieved under objective 3, it is reasonable to expect reduction of tracing clerks in various yard, transportation and traffic offices. Also reduction in telephone and telegraph expenses.

If the new system is designed to provide pre-digested input to the Car Accounting Department — objective 5 — it is reasonable to look for clerical savings in that area, for instance, a reduction in key punch operators.

Savings and benefits. — The greatest potential savings and/or benefits may be anticipated under objectives 1, 2 and 6. Attainment of objectives 1 and 2 will move cars faster through yards and otherwise improve car distribution. This should enable the overall railroad operation to be conducted with fewer cars, saving capital investment or reducing per diem payments. An expedited operation produces a more saleable service; there are also traffic advantages in objectives 1 and 2 as well as in objective 6.

It will be recognized that the economic evaluation suggested above raises questions which can not be resolved mathematically,

particularly those involving per diem savings and traffic advantages which may well be the determining factors. This again emphasizes the need of the interdepartmental or committee approach to develop sound judgment for a wise decision and to assure cooperative action in making the program effective.

Systems of this character are based on yard operations and train dispatchments — a yard-to-yard traffic pattern. For this reason they should be under the line authority of top operating offices. They can delegate this authority to their superintendents and in turn to trainmasters as to the yard phase and to their transportation officers as to the service bureau phase. Staff assistance as to methods and procedures, changes in network, etc., should be provided from headquarters. But strict accountability for performance must be retained. And it should be emphasized that the line officers have the primary responsibility to see that the information which flows from the system is put to work.

Enough roads by now have set up systems of this character to make it reasonably clear that they are worth-while. In all probability the potential benefits of these installations have not yet been fully attained. In an increasingly competitive era it may be assumed that other roads will be constrained to do likewise. It would prove advantageous if all roads employed compatible — not necessarily identical — systems and procedures. This would permit interchange of punch cards, with the interline waybills, thus minimizing the need of further key punching and holding transcription errors to a minimum. Yard-to-yard reporting and centralized processing of movement and traffic data is but one phase of the rapidly expanding field of paper-work automation.

This report is submitted as information with the recommendation the subject be discontinued.

Heavy braking on long grades upped wheel defects, so now the U.P. mainliners use disc brakes.

(*Railway Age*, December 9, 1957.)

By January 1, 1958, the Union Pacific will have almost 100 % of its modern main-line passenger cars equipped with Budd disc brakes. With 385 cars now equipped, a few cafe-lounge and baggage cars are all that remain. Present applications include five sets of equipment for the

(T.F.M.) disc brakes. Present conversions consist of 29 cars, built in 1941. Twelve of these cars will be equipped with outside swing hanger trucks and disc brakes this year.

The disc brake story began on the U.P. in 1948, with a decision to apply them



The « Challenger » coming down from Caliente, Nev., where the line drops 2726 feet in 75 miles. Here the disc brake proved its worth.

« City of Portland », « City of Los Angeles », « City of San Francisco » and the « Challenger »; six sets of equipment for the « City of St. Louis » and two sets for the « City of Denver », a total of 28 trains with an average of 14 cars per train.

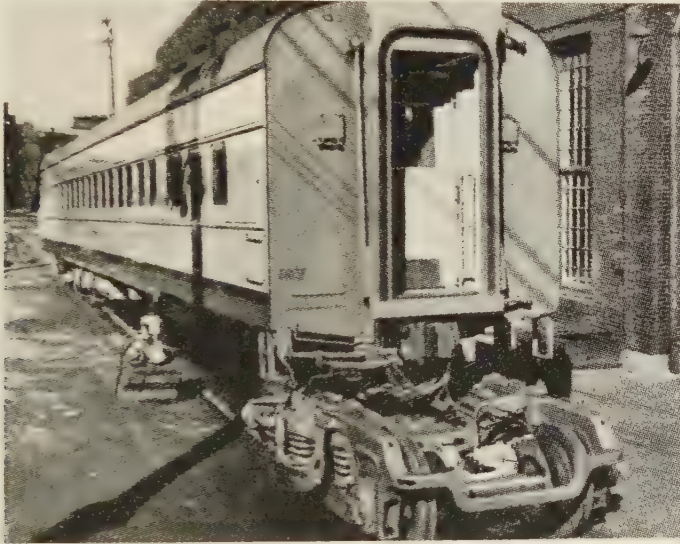
Delivery is presently being taken of 50 head-end baggage cars, built by A.C.F., equipped with General Steel Castings Corporation's 6 in. by 11 in. outside swing hanger trucks and having the latest design

to 100 cars, 50 Budd-built sleepers and 50 Pullman-Standard chair cars. This decision was based on the railroad's primary objective, to get rid of thermal cracked wheels.

Heavy braking grades, prevalent on the U.P. and other western railroads, in combination with lightweight equipment and clasp brakes, were producing these defects in increasing numbers. Records showed this thermal damage to be a safety haz-

ard. Mileages per wheel turning under 50 000 were quite common. Brake shoe life was about 4 600 miles, i.e., one round trip between Chicago and the West coast. In many instances, turned wheels exhibited thermal cracks after only one round trip. It was necessary to examine wheels for thermal cracks after each trip, and no brake shoe was allowed to leave the ter-

In tests made in 1951, two pairs of wheels on the clasp-braked car « Figueroa » operating in the « City of Los Angeles » made thirteen round trips between Chicago and Los Angeles for a total of 59 800 miles before being removed for 6/32 in. tread wear. One pair of wheels on disc-braked car « Pacific Island » made 23 round trips for a total of 105 800 miles



C.F. design brake equipped truck ready for application to U.P. coach.

minal with less than 1-in. wear remaining.

Today, the picture is quite different. Most trains are not braked on the wheel tread. The clasp brake has largely been eliminated and thermal cracked wheels are no longer a major operating problem. The U.P. is getting in excess of 200 000 miles before wheel turning, with 75 000-90 000 miles of individual brake shoe life.

In addition, the disc brake reportedly has cut down car noise, and practically eliminated snow and ice build-up in the trucks, since heat from the brake discs melts it. The truck overhaul period is 36 months, with one-third the labor involved, in comparison with 9 and 18 months on two other types of trucks.

before removal for 6/32-in. tread wear. Another pair of wheels operated 110 400 miles and showed only 3/32-in. tread wear. The disc-brake equipped car « Pacific Bridge » operating in the same service had one pair of wheels removed at 102 000 miles for 6/32-in. tread wear and two pairs at 113 800 miles for 6/32-in. tread wear. Another pair, inspected at 127 600 miles, revealed only 3/32-in. tread wear.

When the first 100 cars were placed in service, they were mixed in with other cars equipped with the clasp brake. After the operating advantages became apparent, new cars and conversions were combined into 100 % disc-braked trains. The U.P. found little or no difference in train hand-

Brake shoe costs on the « City of Los Angeles », Chicago-Los Angeles.

Number of cars in consist (normal)	14
Round trips per year	73
Mileage per round trip	1,508
Annual car mileage	21,112
Brake shoe mileage:	
a) Budd disc brake shoes	20,000
b) Cast iron tread shoes	1,112
Number of car sets of shoe changes per car per year:	
a) Budd disc brake shoes	173
b) Cast iron tread shoes	72.96
Cost per car set of 16 shoes:	
a) Budd — \$ 8.64 by 16	\$ 138.24
b) Cast iron (including labor, overhead and allowing for scrap value):	
1. Standard — \$ 2.99 by 16	\$ 47.84
2. Long — \$ 3.98 by 16	65.68

Comparison of brake material required per car.

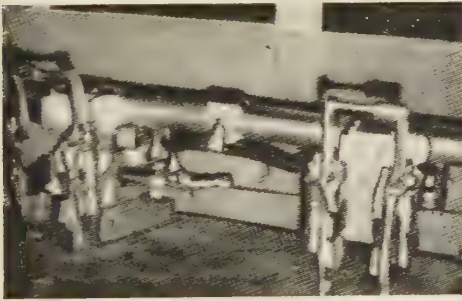
Clasp brake	Description	Disc brake (C.F.)
4 (250 lb. each)	Brake cylinders	8 (40 lb. each)
16 (35 lb. each)	Brake shoes	16 (14 lb. each)
None	Brake discs	8
8	Brake beam	4 (« C » frames)
8	Brake beam stabilizer	None
24	Levers	16 (tongs)
84	Pins	48
20	Hangers	4
20	Support brackets	8
4	Slack adjuster	None
20	Pull rods	None
208	Total number of major parts	112
300 (minimum)	Bushings	78
Yes	Anti-wheel slide	Yes
Yes	Speed governor control	None
Yes	Spark shields	None

Comparative yearly costs — Budd disc brake shoes vs tread brake shoes.

Type of shoe	No. of changes per car year	Cost per change car	Cost per car year	Cost per 14-car train year
Standard C.I.	72.96	\$ 47.84	\$ 3,490.40	\$ 48,807.00
Budd	3.73	138.29	515.82	7,221.48
Calculated savings by use of Budd disc brakes . .			2,974.58	41,644.72
Long C.I.	72.96	63.68	4,646.09	65,045.26
Budd	3.73	138.29	515.82	7,221.48
Calculated savings by use of Budd disc brakes . .			4,130.27	57,823.78

ling, including winter operations, between trains so equipped and those with the mixed consist. It was generally found that the all-disc-braked trains eliminated undesirable jolting and rough stops.

Further advantage included the elimination of slack adjusters, and the necessity of incorporating speed governor control, thus eliminating these additional initial costs and continuing maintenance expenses. A large number of pins, bushings and levers were also eliminated. All moving parts on the disc brake are held under spring compression reducing wear caused by vibration.



T.F.M. brake assembly. C. frame supports are not needed at ends of brake tube and center support to truck transom.

One characteristic of Budd disc-braked cars examined carefully by the railroad was the signal-shunting ability as compared with cars equipped with tread brakes. These tests were run by the U.P. in December 1951, at Gilmore, Neb. This particular location was chosen because the tests could easily be conducted without interference from normal traffic and the rail surface would naturally be in slightly worse shape than the main line insofar as shunting sensitivity was concerned.

Four passenger cars were used; two equipped with disc brakes and two with clasp brakes. These cars were kicked through the track circuit so that the car being tested was the only car in the circuit. Readings obtained on a recording milliam-

meter indicated no difference in shunting efficiency between the two types tested. Other major railroads made similar tests confirming the U.P.'s findings. None of them, including the U.P., used wheel scrubbing devices.

The railroad found that the disc brake has the capacity under continuous braking to control a train of any length and



Safety hook welded to end of brake frame tube overhangs equalizer, C.F. design

on any grade without damage to the brake equipment. Also because the coefficient of friction of the materials used is constant for all loads and at all speeds, and because of the brake's ability to dissipate the heat generated, the train can be reliably stopped in a shorter distance. The pivoted and rubber-backed pin mounted shoes always present the maximum braking sur-

face, and the brake is set to provide a constant free car deceleration of approximately 3 m.p.h. per sec in emergency.

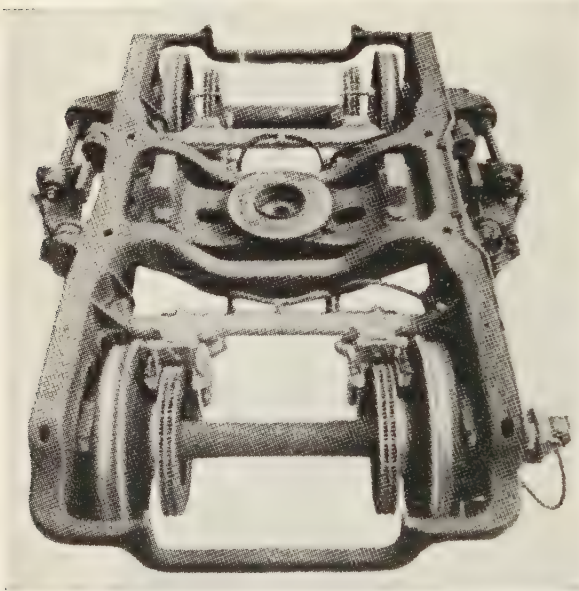
Most of the U.P. cars are equipped with the Model C.F. disc brake, which is mounted on a three-point rubber supported frame. One point is attached to the truck

tube, positioned so that the hook is over the equalizer, and then welded in place. It also serves as a support for the brake assembly during wheel changes, and was adopted as standard.

Permission was given the Budd Company to use this safety device on brakes applied to other railroads having trucks with clearance suitable for its application.

The newer model T.F.M. disc brake design, which is being applied to 55 new U.P. cars, 1 on the Wabash, and 15 existing G.N. cars, is already in service on 114 Milwaukee cars. It offers some design variations as compared to model C.F. For example, it may be considered preferable for converting existing cars to disc brakes because it does not require modification to the journal boxes to provide the support required for the model C.F. Also, certain truck design elements, such as short wheel base or narrow journal centers, may limit clearances, requiring use of model T.F.M. The fundamental disc brake principles are retained and with the exception of the method of attaching the brake assembly to the truck all other components are interchangeable between the T.F.M. and the C.F. design. The latter will continue in production at Budd along with the newer development.

In 1948 an executive of the Union Pacific stated, when it was decided to apply disc brakes to 100 new cars for streamliner service, « After making a thorough study of this subject from all angles, we decided the advantages so far outweighed the disadvantages that it is simply a matter of good business to use the Budd disc brakes ». With substantial operating and maintenance economies achieved in the last nine years covering conversion of the road's passenger fleet, it continues to be « a matter of good business ». The Union Pacific likes the Budd disc brake.



New design T.F.M. disc brake applied to General Steel Casting outside swing hanger truck. Brake frame tube is positioned in cast integral recess in truck frame.

center transom and the other two are supported by resting on the journal boxes. To enhance the safety characteristics of this assembly the U.P. developed a hook arrangement to be applied to 100 of its disc braked cars. This hook, a steel casting, is inserted in the end of the brake frame

Proposed Circle Line for New York.

Plan to revolutionise New Jersey-Manhattan passenger transport.

(*The Railway Gazette*, December 6, 1957.)

Faced with the rapidly-growing traffic in New York City and the expectation that within the next 20 years the population of Greater New York, situated in the States of New Jersey and New York, will have expanded from 15 000 000 to 19 000 000 souls and its urbanised area by 700 sq. miles, these two states decided in 1954 to create a new bi-State authority known as the Metropolitan Rapid Transit Commission to study and report on the problem. After comprehensive examination of all its aspects, and aided by engineering, traffic and financial consultants, Mr. Arthur W. PAGE, Project Director, presented his report to the Commission in May, 1957. The report is embodied in a 53-page brochure reviewed in this issue.

Before considering the recommendations in the report, some idea of present conditions of passenger transport in the area may be obtained from the editorial on another page.

This shows that the most important problem in the near future will be to provide the rapidly-increasing number of commuters (season-ticket-holders), for whom there will be additional residential space in New Jersey State, with adequate transport to and from their businesses in Manhattan. The primary object of the report was, therefore, to present a feasible plan to improve trans-Hudson suburban passenger services.

The over-riding conclusion on which the recommendations in the report are based is that rail service is essential to meet the needs of the area, there being no other practical way of moving the existing 75 000 and many more expected trans-Hudson commuters into and out of Manhattan during the daily peak periods.

Main objectives.

With this end in view, a permanent New Jersey-New York bi-State public agency is recommended with wide powers: (1) to improve the existing non-paying railway service on the various suburban lines delivering passengers to the west bank of the Hudson; and (2) to extend the New York City rapid transit system across that river into New Jersey to provide direct access from existing railway and highway terminals on the west bank to all parts of Manhattan south of Central Park.

The agency or authority will thus require powers: (a) to construct new rapid transit facilities and acquire or control the suburban service properties of the railways in New Jersey; (b) to arrange for the operation of these properties under its own or the present owners' control; (c) to improve and expand the service by modernisation; (d) to initiate new services and abandon existing ones; (e) to determine fares and standards of services; (f) to contract for or operate feeder bus services where rail service is not justified; and (g) to have access to tax sources and other public funds to meet deficits.

Foremost among the above improvements envisaged are the replacement of about half of the old coaches still in service — of 1 300 only 150 are at present air-conditioned — the relocation of stations to provide adequate parking space and to speed up services by reducing the number of station stops, and the provision of good access to highways. Other improvements recommended are the amalgamation of duplicate services and terminals, the provision of adequate bus services where preferable to rail services, either as feeders



The New Jersey-Manhattan area of New York, showing the route of the proposed circle line.

to the existing New Jersey railways, or as direct services to a new trans-Hudson loop line on the west bank or into Manhattan by road tunnel.

The recommended plan consists of a closed loop or circle railway provided by new construction: (a) from 57th Street Station on the Brooklyn & Manhattan Transit line via Columbus Circle and 59th Street to the Hudson River; (b) under the river in twin tunnels; (c) onwards in New Jersey to an interchange station with the West Shore lines; (d) southwards to interchange stations with the Erie system (at Sasquehanna Transfer), the Delaware Lackawanna & Western lines near Hoboken, the Hudson & Manhattan trans-Hudson tube, and the Central Railroad of New Jersey; (e) in a second pair of twin tunnels back to Manhattan at Battery, to rejoin the Brooklyn & Manhattan Transit line near Cedar. By using the excess capacity of the B.M.T. line — mainly under Broadway — from Cedar to 57th Street, a circle will be provided serving Manhattan with frequent stations from Central Park to Battery (Midtown and Downtown areas).

Trains will run in both directions on the two tracks — the complete circle time being about 40 min — offering a choice of directions as most suitable. The New Jersey section of the circle will intercept every Hudson-bound suburban line as well as every highway in being or to be built in future south of the George Washington Bridge over the Hudson. Wherever rail, bus, or motor-car passengers reach the new loop line they will have the choice of going by the northern part of the loop to the Midtown business area via 59th Street, or southwards to the Wall Street area via Battery, as well as to all intermediate points in Manhattan.

The scheme provides ample capacity to meet maximum peak-hour commuter traffic and adequate reserve for traffic growth. The authority would also be empowered to contract with the City of New York for making connections between the bi-State

loop and the existing rapid-transit underground system and for running powers over its lines.

Hudson & Manhattan Tube.

Complementary to the loop-line construction the modernisation of the downtown tubes of the Hudson & Manhattan would be undertaken, and if considered desirable in future years, rapid-transit services could be extended outwards from the loop along one or more of the suburban railways.

The immediate advantages claimed for the scheme are greatly-increased comfort and convenience for commuters, an average saving of time of 15 min in each direction, the elimination of at least one interchange for most existing rail passengers, and their delivery within walking distance of their destinations in Manhattan. Bus and car passengers can board loop trains in New Jersey and be carried quickly and conveniently to anywhere in the business area free from delays on river crossings and in city streets. Ample parking space will be available for them at all loop stations.

Moreover, the improved services will benefit many more than the 140 000 passengers using them daily including slack-hour traffic. Residents and would-be residents in the rapidly-developing outer suburbs in New Jersey can be sure of this first-rate transit to their city offices and back; in the part of New Jersey within one-hour's travel time from Manhattan by the new system the population is expected to increase by nearly a million by 1975.

The total estimated cost of the whole project to be undertaken by the bi-State authority is some £ 143 000 000, including (a) £ 20 000 000 for replacement and modernisation of about half the existing rolling stock, (b) provision for the modernisation of the Hudson & Manhattan lines into Hudson Terminal in Manhattan, and (c) about £ 5 000 000 for improved parking and suburban stations in co-operation with the communities concerned. This sum would have to be obtained by public

loan backed by the States of New York and New Jersey.

The present annual deficit on the New Jersey railways is no less than £4 650 000 under private operation. But savings under bi-state control are estimated to be £2 860 000 as a result of railway amalgamation, ferry elimination and working savings on the new rolling stock, so that the net operating deficit on the suburban lines is expected to be only £1 790 000. There will, however, be a deficit on the working of the loop system of just over £1 000 000 and on the railway improvement programme of £1 425 000, so that a

total annual sum to be met by taxation will be about £4 250 000. It is proposed that the necessary tax levy should be apportioned among the 12 New Jersey and two New York counties west of the Hudson, and New York City on its east bank, according to the extent to which each directly benefits from the improved service.

Several alternative schemes were examined in detail, but though they had their advantages their higher costs or greater disadvantages ruled them out. They included suspended monorail and aerial transit proposals which, however, proved unfeasible.

The work of the Railway Clearing House.

Varied services for British and Irish railways and steamship companies.

(From *The Railway Gazette*, 20 December 1957.)

The dissolution of the Railway Clearing House as a body corporate on April 8, 1955, did not mean the end of its work or its usefulness to British Railways and other activities of the British Transport Commission. Its Secretarial and Traffic Departments still provide many services of the greatest importance to the nationalised transport undertaking.

The railway clearing system was instituted in 1842 with the object of facilitating the through booking and movement of passengers and goods, with the Railway Clearing House as a central and neutral establishment to apportion the receipts among the carrying companies. The Railway Clearing Act, 1850, gave the Clearing House legal status in securing the payment of declared balances, and under the provisions of the Railway Clearing Committee Incorporation Act, 1897, the Railway Clearing House became a body corporate with its own seal.

From then onwards many other duties were placed on the Clearing House by statute, and a wide range of miscellaneous non-statutory duties, beyond its original purpose as a Clearing House, were also performed for and on behalf of its members (British and Irish Railways) and other transport interests such as shipping companies.

The clearing system was administered on behalf of delegates appointed by the boards of the railway companies. Before January 1, 1948, each main-line company was represented by four delegates and each other party-railway by one delegate; and the day-to-day affairs of the House were controlled by a Superintending Committee of eight directors of the main-line companies appointed by and from the delegates.

On January 1, 1948, the undertakings of the railways in Great Britain, parties to the clearing system, were vested in the British Transport Commission, and the number of parties was reduced to five — British Transport Commission, London Transport Executive, Ulster Transport Authority, Great Northern (Ireland) Railway Board, and Coras Iompair Éireann. In addition, there were 14 non-party companies, including steamship companies, for whom work was done by the Clearing House.

The British Transport Commission was required, under Section 38 of the Transport Act, 1947, to prepare a scheme as to the property, rights, powers, and liabilities of the Clearing House, and, until otherwise provided by such a scheme, the Acts governing its constitution continue to have effect.

The Transport Act, 1953, did not change this position, and on February 4, 1954, Mr. John Boyd-Carpenter, who was then Minister of Transport & Civil Aviation, made an Order embodying the scheme submitted by the Commission. This provided for the transfer of property, rights, powers, and liabilities to the Commission, and for the staff to become servants of the Commission as from May 24, 1954. The scheme also provided for the dissolution of the Clearing House Corporation at a later date, when the Corporation had secured the transfer to the Commission of any foreign property and debts, to which the scheme did not apply. The body corporate ceased to exist in 1955, after publication of a certificate by the Minister in *The London Gazette*, *The Edinburgh Gazette*, and *The Belfast Gazette* to the effect that there was no longer any reason for its continued existence. The line of Chairmen, which had

started with George Carr Glyn, afterwards the first Baron Wolverton, ended with Mr. K. W. C. Grand, General Manager, Western Region, British Railways.

Great pleasure was caused by the Commission decision to retain the name « Railway Clearing House » as descriptive of the organisation. A Management Committee of five members, with Sir Reginald Wilson, Member of the Commission, as Chairman, was appointed to control Clearing House affairs on behalf of the Commission. This committee was reconstituted later, and Mr. K. W. C. Grand became its Chairman.

Responsibilities of committee.

The committee is responsible for ensuring that the organisation functions to the best advantage in relation to the whole of the Commission undertaking and for the exercising of overall supervision of the work of the Clearing House and dealing with matters of importance. The committee meets as necessary for these purposes.

At its first meeting on May 17, 1954, the committee decided that overall supervision of the Clearing House should be exercised through a senior officer located at Eversholt Street; that Mr. T. J. Lynch (the then Secretary to the R.C.H. Corporation) should be appointed to that duty, with the title « Secretary, Railway Clearing House »; that subject to review as might later be desirable, the authorities previously vested in, and the responsibilities placed on, Mr. Lynch by the R.C.H. Superintending Committee should be exercised by him on behalf of the new committee; that the committee should meet at three-monthly intervals to receive reports from the Secretary on the staff and work of the establishment, and to deal with any matters of importance which might require their approval or decision; and that in the interval between meetings the Secretary should be responsible directly to the Chairman.

Organisation.

The work of the Clearing House is organised in two departments, « Secretarial » and « Traffic », with common

services catering for both. The Secretarial Department is concerned mainly with the provision of secretarial services for conferences and committees. These bodies deal with matters relating to nearly all branches of the Commission activities, and frequent meetings to discuss matters of mutual concern are arranged as need arises between Commission representatives and those of coasting liner and tramp shipping, airways, independent road hauliers, Government departments, trade associations, and individual traders. Certain other sections of work, although not strictly secretarial, are brought within the department as an administrative convenience.

The Traffic Department is engaged mainly on accounting and auditing work on behalf of British Railways.

Secretarial department.

The Secretarial Department provides secretarial services for conferences and committees. These numbered 210 at the end of 1956. The services include attendance at meetings; preparation and circulation of agenda, minutes, reports, memoranda; collation of statistics; correspondence; filing; and recording. Books of regulations, instructions, charges, and so on, are prepared as required. During 1956, these services were provided for 1 992 meetings, most of which were held in the committee rooms at Eversholt Street. Accommodation was also provided at Eversholt Street for 167 meetings of committees for which the Clearing House did not perform the secretarial work.

At eight points throughout the country, there are Area Secretaries who work in conjunction with the Road Haulage Association to provide secretarial services for Road/Rail Negotiating Committees dealing with road licensing matters. They attended 995 meetings during 1956.

The Department is also responsible for the preparation, printing, and, where this is permitted, sale to the public of railway maps, the official « Handbook of Stations », rates books, scales of charges, and so on. In all, there are some 60 such publications.

Amending leaflets or revised issues are published as necessary.

A central organisation was set up in 1949 to deal with all matters of classification of merchandise, previously dealt with by R.C.H. standing committees. With the introduction of new methods of freight charging on British Railways last July, based on « loadability » and not classification, the responsibilities of the Clearing House in this direction have been considerably modified. Matters affecting the carriage of dangerous goods and explosives continue to be dealt with by this section.

In 1950, a central organisation was set up to deal with all general claims and packaging matters previously dealt with by and through R.C.H. standing committees. The organisation includes a package-testing laboratory where packages and internal packings are scientifically tested and, if satisfactory, certified as suitable for the conveyance of goods at carrier's risk. Where packages fail the test, advice is given to the casemaker or trader on what modifications should be made. During 1956, 2518 different types of pack were submitted for test, of which 80 % were certified as complying with the required standards.

A member of the staff represents the Commission on various « outside » bodies such as committees of the British Standards Institution concerned with packaging affairs. There is also regular collaboration with the principal casemakers and research services, and liaison — for the exchange of information and experience — with Continental and American railways.

An organisation set up in 1948 records, by mechanical (Hollerith) processes, all British Railways' wagon, coaching, container, sheet, and rope stocks. Before nationalisation, each main-line railway kept the records of its own stock, in some cases manually and in others by machines, and the R.C.H. kept the records of privately owned wagons. These individual records — which were not all kept in the same form — are now concentrated on the central registry as a complete uniform record of all stocks.

The records are kept up to date, involving the withdrawal of « condemned » stock, averaging some 25 500 items per month, and the inclusion of new stock, averaging 25 000 items per month.

A wide range of tabulated information is supplied weekly, monthly, quarterly, and annually, mainly for the Engineers', Accountants', Operating, and Commercial Departments, for purposes such as depreciation accounts, Commission published statistics, building programmes, and so on.

The Registry arranges the sale of condemned ex-privately owned wagons for breaking up or for internal use by collieries and so on. Some 3 500 a month are sold at a value of about £ 76 000.

Another function is the examination of consignments at goods stations and depots to determine the correctness of the consignors' declarations of weight and contents, and to ensure that consignments are adequately protected for normal transit and properly addressed and labelled. In the case of dangerous goods, consignments are examined to ensure that the correct warning labels are used and that packing and protection comply with the special regulations. Where necessary, the inspectors visit firms to give advice on these matters.

Inspectors also visit docks to correct the misuse of railway vehicles, wagon sheets, and other equipment. They ensure that proper charges are raised against the Port of London Authority for stock used irregularly in its docks, and clerks are stationed at those docks to assess demurrage charges on shipment traffic through the docks.

Traffic Department.

The arrangements under which, before nationalisation, debits and credits were transferred between stations and other accounting points within the separate railway companies, and audited by the company, were extended on May 1, 1950, to cover transfers between any two points on British Railways. The monthly checking, auditing, and balancing operations are now concentrated at the Clearing House. The Traffic Department also carries out the

audit of stations' monthly summaries of merchandise traffic by freight and passenger trains, covering the whole of British Railways.

Another activity is the operation of the « Warrant Travel » scheme, under which firms and other organisations can obtain tickets for any journey over British Railways, Irish railways, and independent steamship companies without payment at the time of booking, on presentation of a warrant at the booking office.

Each firm is required to deposit with the Clearing House a sum equivalent to roughly six weeks' expected travel. At the end of each month the railways and shipping companies send all exchanged warrants to the Clearing House, showing the fares chargeable. From these a monthly account is compiled mechanically and rendered to the firm. Payment is made to the Clearing House, which credits the railways and steamship companies with the value of the warrants exchanged. The number of accounts open at the end of 1956 was 4 026, and the total value of warrant travel in that year (to November 30) was more than £6 million.

The Clearing House is the channel through which railway stations and offices are supplied with accident and baggage insurance tickets and vouchers for sale at booking offices on behalf of the Railway Passengers Assurance Company, and through which receipts from this business are accounted for to the assurance company. Each station sends a monthly return showing tickets, and so on, sold and premiums paid, from which statements are prepared showing the amounts due to the assurance company from each Region or company, after allowing for commission.

The examination of G.P.O. returns and records for purposes of checking and agreeing with the Postmaster-General the amount due to the carrying companies for the conveyance of post-office parcels is performed by the Clearing House. The preparation — in collaboration with the Irish Clearing House — of accounts, and the apportionment of parcel post revenues between the carrying companies also is car-

ried out. In 1956, the total amount involved was more than £9 million.

Yet another function is the division of receipts from through-booked merchandise traffic between British Railways and Southern Region Continental ports, for the purpose of ascertaining the proportions accruing to « rail » and « boat ». This information is used in connection with the pool of cross-Channel receipts between British Railways and the French National Railways.

Common services.

The internal accounting section deals with the accounting of Clearing House expenses and proportionate charging out to administrations among its duties. The staff section is responsible for the annual census of all railway staffs, on behalf of the Railways Staff Conference, as well as many other duties.

The Railway Clearing System Superannuation Fund is an independent corporation. Its affairs are administered by a Council of six, five appointed by the British Transport Commission and one by Irish contributing bodies, with Mr. K. W. C. Grand as Chairman, and a Management Committee of 12 comprising the Council of six, and six appointed by the contributing members. Members and superannuitants include employees and/or retired servants of all branches of the Commission, certain Irish railways, and the Irish Clearing House.

Staff.

In 1921, the staff of the Clearing House numbered 3 400, the majority being employed on the work of dividing traffic receipts between the many railway companies, British and Irish, then party to the Clearing System. With the considerable lessening of the need for such divisions following the amalgamation of railways in pursuance of the Railways Act, 1921, the later complete abolition of all receipts division (except cross-Channel and Irish traffic) following the Act of 1947, and the gradual introduction of machines for accounting and statistical purposes, the number of employees fell steadily to a figure of 455, all grades, on December 31, 1956.

Competition in connection with the problem of the hunting of railway vehicles.

(Note communicated by the Research and Trials Office — O.R.E.)

In 1953, the Research and Trials Office (O.R.E.) of the International Railway Union (I.R.U.) suggested to the Management Committee of the I.R.U. (U.I.C.) in December 1953 the running of a competition open to all research workers, for theoretical research into the problem of the hunting of railway vehicles. The suggestion, which was agreed to, included the award of prizes to the best memoirs sent in.

The Competition was published during May 1955. About 200 persons or institutes asked for particulars about the Competition and its conditions of entry. When it closed in August 1956, the Competition had received 17 memoirs.

After these memoirs had been studied by the international Jury set up for this purpose, it was decided that only 5 of them were of any interest. Finally, at its last meeting on the 12th June 1957, the international Jury decided to award three prizes. This award of prizes does not imply in any way that the works in question solved the question. In reality, none of the memoirs entirely covered the problem set, but they all give acceptable solutions or solutions which it would be interesting to go into more thoroughly. Summaries of the prize winning memoirs are given at the end of this article.

When the Jury had made their decision, the notary proceeded to open the sealed letters containing the names of the authors of the winning memoirs. This showed that the three winning memoirs were written respectively by :

— Professor DE POSSEL, of Algiers University;

— M. Jean BOUTEFOY, engineer attached to the Traction Department of the Alsthom Company in Paris;

— and the « Railway Technical Research Institute » of the Japanese National Railways, Japan.

The distribution of prizes by Dr.-Eng. DEN HOLLANDER, Chairman of O.R.E. took place in Utrecht on the 11th July 1957. The two European authors were present, whilst the Railway Technical Research Institute was represented by the Japanese Embassy to Holland.

Summary of Professor R. de Possel's memoir.

As far as we know, the studies on hunting made to date has concentrated on the linear friction and conicity of the tyres (for ex. Y. Rocard), the differential system then being linear.

Retaining the hypothesis of the linear friction, but taking it that the rails and tyres are worn, with profiles similar to those given in the conditions of the competition, it is possible to represent the various functions which come into the equations by approximate expressions, so that the system is still linear but with a different form.

The term in which the conicity of the tyre is included, viz $\beta = 1/20$, is replaced by a similar term in which β assumes the value 0.463 for the given profiles. A supplementary term is added due to the variation in the direction of the normal at the point of contact; this term brings in another constant. The results differ considerably from those obtained with a

conical wheel, even in the case of very slight hunting. We have studied these results, taking into account the rolling and rail-wheel deflections.

The hypothesis which consists in assimilating the tyre to a cone appears to us illusionary, at least in the case of running in a straight line, and with a four wheeled frame.

When the law of linear friction leads to stability, any small irregularity in the track will give rise to hunting which is rapidly damped out, as the study we have carried out shows. In the contrary case, its amplitude will continue to increase until it leaves the linear field, and the movement will tend to become in fact a periodic movement of the limit cycle of the system of equations which corresponds to non linear friction.

We have introduced four different deflections at the four contacts. It appears that so far equal deflections have been considered for each of the rails on the front and rear wheel. These deflections only come into account through two linear combinations. Taking the rolling into account, the system is then of the 8th order. We have studied the stability in the numerical example suggested, at different speeds. We have compared the results with those obtained in particular cases in which the deflections, the rolling, or both have been left out. In this latter case, we get a stability of the solutions of the linear system up to fairly high speeds, whereas with conical wheels it is more or less general to find instability at all speeds.

The non linear system which we have obtained did not seem to us to come into the cases studied so far. It is perhaps possible to discover the limit cycles by numerical integration, but we had not time to carry our research so far. Suitable methods of calculation would no doubt be needed. When establishing the equations, we did not presuppose a strictly uniform rotation of the axles.

Finally, there are probably periodic solutions of the problem with shocks of the flanges against the rails, but the equations

at which we arrived seemed to us too complicated to discuss in the time available. An examination of the worn rails moreover led us to think that this processus only comes into play exceptionally.

The extension of our results to the cases given in the conditions of the competition, such as dissymmetrical vehicles, with several axles or frames, to running through curves, would not present any difficulty, since the most important part of the results we obtained relates to the case of a *single axle*.

Summary of M. Boutefoy's memoir.

The object of the present study is to examine the influence on the stability in running of a railway vehicle of the flexibility of the vertical suspension which acts upon the value of the « rolling period ». Internal damping out of the suspension has been neglected.

The equations establishing the dynamic equilibrium of the system were established according to the method given by M. Rocard in « *Actualités Scientifiques et Industrielles* », taking it, as M. Rocard did, that there is a linear relation between the tangential force and the angle of false-slide.

In view of the particular profiles of rail and tyre set out in the conditions of the competition, it has been shown that it is necessary to attribute to the conicity of the tyres the value of 0.4, this being defined as the ratio between the variation in radius of a wheel and the value of the transversal displacement of the axle which has caused this variation in the radius. It has also been shown that the areas of contact of the two wheels of an axle upon the rails do not have the same inclination to the horizontal so that the support reactions have a transversal component which is not negligible and tends to centre the axle in the track.

The application to this system of the « *Hürwitz conditions of stability* » lead to the defining of a « *limit speed of stability* » and to giving the value as a

function of the principal parameters of the vehicle and the characteristics of the track (wheelbase, moment of inertia, vertical flexibility of the suspension, period of rolling, conicity of the tyres, transversal rigidity of the track).

An endeavour was made to check these results by means of an experimental study using a model of a wagon with two axles.

Finally, we dealt with the application of the method of calculation to the case of a bogie vehicle.

Summary of the memoir of the « Railway Technical Research Institute » Japanese Railways.

Memoir No. 46323330 is divided into two parts: a theoretical part which will be described, and a purely practical part.

Hunting is studied first of all for an isolated axle, then for a vehicle having

two axles, with the following particularities:

- rolling of the body is prevented;
- there is no transversal deformation of the rails nor of the wheels;
- the axles move relatively to the body, such movements being limited by the recall devices.

The equations used are entirely linear and do not take into account the effect of transversal recall caused by the variations in the inclination in the tangential plan of the contact between wheel and rail. They are therefore only valid for the case in which the wheels are perfectly conical.

The calculations lead to the determination of the limits of stability, taking into account the connections between the axles and the body.

Rail-mounted trench-digging machine.

Drastic reduction in labour costs in the Western Region through mechanised digging of surface water drains alongside track.

(From the *Railway Gazette*, March 21, 1958.)



Front view of trench-digging machine with excavating bucket chain in raised position.

Believed to be the first of its kind in the world, a rail-mounted trench-digging machine developed by the Western Region of British Railways enables seven men to do the work of 40, in less than one-third of the time, when excavating trenches for surface water drains alongside the track. The machine saves 86 per cent of labour costs on the site, the major portion of expense in any drainage scheme. It can dig a 6-ft. length of trench, 6 ft. deep and 2 ft. wide, in one min.

In the past two years, since final modifi-

cations to the prototype were completed, this machine, working only on Sundays with a team of seven men, has excavated 16 000 yd. of drain trench in 486 hr., at the same time loading the spoil into wagons.

Labour saving.

Had this work been done by manual labour it would have taken 40 men 1 700 hr. to complete. The nine miles of trench were excavated in varying depths to 6 ft. in all types of soil and formations, including boulder-strewn ground.



Excavation in progress at Churchdown.



Work in progress at Churchdown, showing how forward movement for digging is effected by the hydraulically-driven winch winding in on a rope attached to the track ahead.

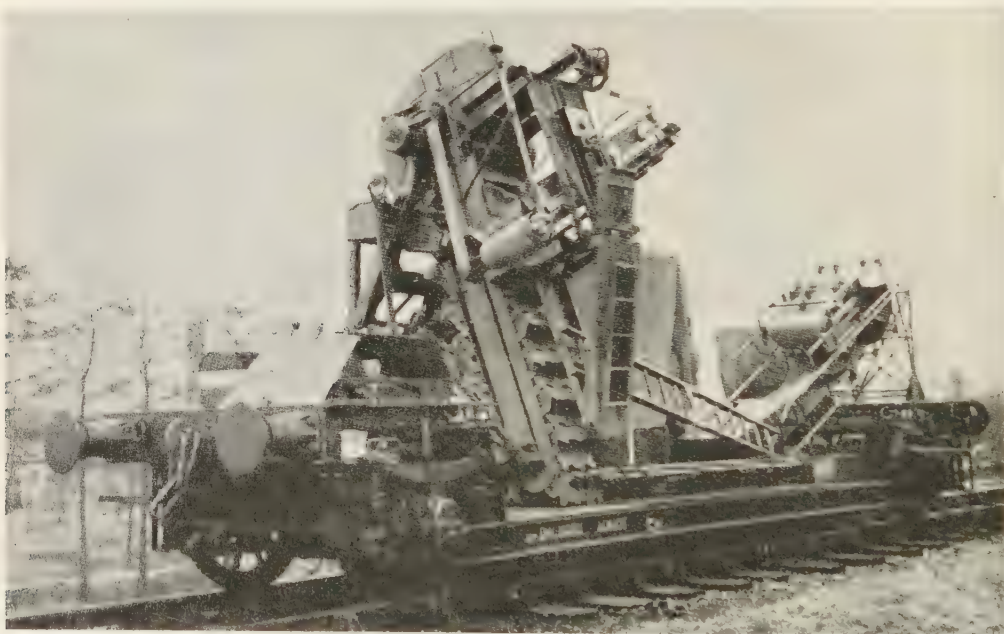
The estimate of 86 per cent labour cost savings is based on the size of the trench being the same whether done by machine or by hand. In actual working, if the work were done manually a trench 6 ft. deep would have to be wider than 2 ft.; thus the ratio of saving between the two methods would be greater than 14 to 86 per cent.

Another advantage of this means of excavating track drainage trenches is that work can be undertaken which would be impracticable by manual methods alone. If

The transmission is by a Plessey pump which supplies the hydraulic pressure to motors supplied by Andrew Fraser.

Essentially the digging unit is a modified arrangement of the Barber Greene ditcher mounted on an adjustable outrigger, which in turn is secured to a rotating base for bringing the unit within load gauge when travelling.

The traction while digging is obtained by a winch winding in a wire rope anchored to the track ahead. The forward speed is



Trench-digging machine in position for normal transport by rail, accommodated within the loading gauge, showing outrigger rotated into stowing position.

drainage on these sites were abandoned because of this, much more costly remedial works would, in time, be necessary to re-establish the track in a safe condition.

Engine and transmission.

The rail-mounted trench digger is driven by a 48-h.p. Perkins P6 diesel engine. The power to all motions is transmitted hydraulically.

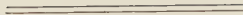
infinitely variable between 1 ft. and 6 ft. a min. The width of the trench is normally 2 ft. and the depth can be varied, while excavating, down to 6 ft. below rail level. The distance from running face of the nearest rail to the centre of the trench is adjustable between 3 ft. 3 in. and 5 ft. 3 in. Another adjustment can be made when digging on curved track with cants up to 4 1/2 in. to keep the bucket line vertical.

The weight of the machine in working order is about 30 tons, and during the past two years it has operated without significant mechanical failure.

The prototype design and manufacture of the original rail-mounted trench-digger was done in co-operation with Jack Olding & Co. Ltd., Hatfield, and the radical modi-

fications to the machine were carried out under the direction of the Chief Civil Engineer of the Western Region, Mr. M. G. R. Smith, by Auto-Mower Limited, of Norton St. Philip, Bath.

At the present time, the machine is working at Redhill Junction, three miles south of Hereford.



OBITUARY.

SIR JAMES MILNE,

Former General Manager, Great Western Railway (Great Britain).

Former Member of the Permanent Commission of the International Railway Congress Association.



We have learnt with great regret of the death on the 5 April last of Sir JAMES MILNE, General Manager of the Great Western Railway from 1929 to 1947, and former Member of the Permanent Commission of our Association.

The following particulars of his railway career have been extracted from « The Railway Gazette » :

« Sir JAMES MILNE, who was born in 1883, joined the G.W.R. as a pupil in the Locomotive Department in 1904 and, after passing through the Swindon shops, mechanical laboratory, and drawing office, transferred to Paddington. He had experience in the office of the Superintendent of the Line and, later, in the General Manager's Office.

In 1912, he returned to the former office, where he took charge of the Passenger Train Running Department.

In 1916, he was appointed Chief Clerk to the Divisional Superintendent at Pontypool Road, and was for a short period Acting Divisional Superintendent, Swansea.

In 1917, he became Assistant Divisional Superintendent, Plymouth.

In 1919, his services were requisitioned by the Minister of Transport, under whom he was Director of Statistics. Subsequently, he was selected to assist the Geddes committee on National Expenditure.

On January 1, 1922, he was appointed Assistant to the General Manager, G.W.R., and in the following April, became Principal Assistant.

Later the same year he was selected by Lord Inchcape to assist the Indian Retrenchment Committee, and was one of the co-signatories to its report.

He returned to Paddington in April 1923. In the same year he received the honour of the C. S. I. He was appointed Assistant General Manager in 1924 and in July, 1929, succeeded Sir Felix Pole as General Manager.

He became a member of the Committee of Inquiry into the Coast Guard Organisation in 1931. He was knighted in 1932, and created a K.C.V.O. in 1936.

Sir JAMES MILNE was a member, from its inception, and Deputy Chairman from 1941, of the Railway Executive Committee, and took a leading part in dealing with the problems incidental to railway operation during the war and post-war periods.

In 1940, he was selected a Director of the Great Western Railway Company, retaining the General Managership.

In 1941, on ratification of this directorship, he resigned from the board of the G.W.R. This was done in deference to the wishes of the Minister of Transport, who could not accept him as a director of a railway company while he continued to serve on the Railway Executive Committee. The Minister also stated his desire for Sir JAMES MILNE to continue his service with that committee.

Sir JAMES MILNE was a former Member of Council, and a former Vice-President, of the Institute of Transport. He resigned the General Managership of the G.W.R. in 1947. »

Sir JAMES MILNE was a member of our Permanent Commission from October 1946 until he resigned the position of General Manager of the Great Western Railway.

In spite of his heavy duties, he always showed the greatest interest in the works of our Association.

Sir JAMES MILNE was a faithful friend of our Association and his affable character earned him the sympathy and admiration of all his colleagues on the Permanent Commission.

We offer to his family our sincere condolences.

The Executive Committee.

NEW BOOKS AND PUBLICATIONS.

[385 (09 (45)]

Uno Sguardo alle Attività delle F.S. nell' anno 1957 (*Report on the Activities of the Italian State Railways during the year 1957*). Communication of the General Management of the F.S.-Extracted from the review *Ingegneria Ferroviaria*, No. 1, January 1958. — One brochure (8 3/4 × 11 1/2 in.) of 51 pages, with 51 figures. — 1958, Roma, *Ingegneria Ferroviaria*, Piazza Crosse Rossa.

M. RISSONE, the General Manager of the F.S. has reported in a pamphlet with this title, published by « *Ingegneria Ferroviaria* » on the activities of the F.S. during 1957, the first year of the five year plan drawn up in view of the European Common Market.

The most striking points of the different departments are reviewed in 51 illustrated pages: work and constructions (permanent way, bridges, infrastructure, reconstruction of lines closed as a result of the war, station buildings, homes for the staff), electrical installations (catenaries and substations for the new lines, especially in the South, signalling, including the Bologna centre and the main Naples station, telecommunications), rolling stock and traction (T.E.E. rakes, diesel-mechanical and diesel-

hydraulic rail motor coaches, couchette-cars, bi-current electric rail motor coaches, telephone exchange wagons, shops), traffic (extensions to the services, participation in Interfrigo), commercial (trials of free access to station platforms, seat reservations, introduction of mechanographical equipment), stores (increase in imports of American coal), finances (intervention in Eurofina, reorganisation of the departments), staff and social services, and the Research Institute.

This list shows the very great variety of fields affected by the five year plan, every part of which must cooperate harmoniously in improving the profitability of this beautiful and extensive railway system.

P. Sch.

[385 (09 (44)]

Activité et productivité de la S.N.C.F. en 1957 (*Activity and productivity of the S.N.C.F. during 1957*). — One brochure (8 1/4 × 10 5/8 in.) of 32 pages, with maps, diagrams and tables.

As it has done every year since 1950, the S.N.C.F. has just issued a pamphlet for 1957 giving the main results of its activities. There has been a remarkable increase in traffic (6.8 % in the case of freight and 5.8 % in the case of passenger traffic). As the number of employees has again been slightly reduced, productivity has reached a new high level.

The pamphlet mentions the main technical progress made (electrification of 225 km, hauling heavy trains with diesel locomotives, new railcars, extension of both the manual and automatic block and light

signals, a further 780 km of permanent way equipped with long rails), the progress of its commercial and co-ordination policy (C.E.C.A. tariffs, T.E.E. services, auto-couchette trains, wagons to take heavy road lorries and semi-trailers of more than 20 t), and the extremely large programme in connection with its administrative management (high power electronic equipment, operational research).

Numerical data are given by means of 7 graphs and maps as well as 10 tables.

P. Sch.

[669]

Les Chemins de fer et l'Acier (*Railways and Steel*). — Prepared by the « Section de l'Acier, des Industries Mécaniques et de l'Habitat » of the European Economic Commission. — One brochure (8 1/4 × 11 in.) of 64 pages, with numerous tables. — 1958, Geneva, Department of Economic and Social Affairs, European Office of the United Nations, Palais des Nations (Price : 2.50 Swiss francs).

Continuing its studies on tendencies in the production and consumption of important steel products, the European Economic Commission of the United Nations Department of Economic and Social Affairs has devoted a report to the consumption of steel in the railway field.

A study of this question is justified not only by the importance of the field in question — 8.7 % of the world consumption of steel is used directly or indirectly by the railways — but above all by its special characteristics: instability of demand, less accentuated progression than in the case of other steel products during the last twenty years, uncertainty as regards the probable future level of consumption owing to the financial difficulties from which most railway administrations suffer, and the creation of centres of production of constantly increasing importance in countries that up to now have imported railway material.

After collecting together the figures relating to the production of equipment and rolling stock from 1936 to 1956, the report analyses the principal factors likely to affect the present and future demand for steel on

the railways and from the official forecasts gives data concerning the probable future consumption.

The report after also studying the perspectives offered by exports, concludes that railway requirements of steel will be maintained at present levels for the next few years, but there will be a regular decrease in the world demand now met by the traditional exports of railway equipment and rolling stock.

It is then suggested that in order to facilitate the adaptation of the steel industry — as well as the rolling stock industry which is also covered by its conclusions — to a retrogressive demand, there should be greater concentration of productive capacity which would encourage capital investment and assist the industry in meeting the competition of new producers, and on the other hand concerted action by consumers, if not by means of an international association, at least on the national plane, in order to determine their long term requirements and spread these out over a sufficiently long period.

R. S.

[385 (03)]

INTERNATIONAL RAILWAY UNION (*International Railway Information Office*). — **Lexique Général des Termes Ferroviaires.** (*General Dictionary of Railway Terms*) — One volume (6 × 8 3/4 in.) of 830 pages. — 1957, Paris, International Railway Union, 10, rue de Prony. (Price : Bound in cloth : 2 200 Fr. Francs or 23.20 Swiss Francs).

The International Railway Union has just published the first edition of the « Lexique Général des Termes Ferroviaires » drawn up by the International Railway Information Office.

This dictionary in French, German, English, Spanish and Italian, includes a total of more than 50 000 terms or expres-

sions used in the various branches of railway activities.

It consists of two parts:

— the first is a synoptic table of the corresponding terms in the five languages;
— the second is an alphabetical index for each of the other four languages than French.

The synoptic table gives the terms in their alphabetical order in French, so that no index is needed for this language. On the same horizontal line, there is the French term followed by its translation in the other four languages. Each line is designated by its order number.

This same order number is also given beside each term in the alphabetical index, thus making it easy to relate the index to the synoptic table and find the transla-

tion of the term in question in each of the other four languages.

The « *Lexique Général des Termes Ferroviaires* », the extension of which into other languages is already under consideration, will be invaluable to all those who for various reasons have to read, translate or write technical articles, books or correspondence in connection with railway transport.

R. S.

[621 .13 (09.3)]

ALLEN (Peter). — **On the Old Lines. Locomotives round the world.** — One volume (7 · 8 1 4 in.) of 186 pages with copious illustrations. — 1957, London : Cleaver Hume Press Ltd. 31, Wrights Lane, Kensington, W. 8.

This work by MR. ALLEN is written in praise of the steam locomotive.

The author gives therein a very important personal photographic documentation, which he has collected during the numerous journeys he has made in all parts of the world.

As a true « hunter of pictures », he has lingered and taken pleasure in the old locomotives, rather than the modern powerful locomotives, those which carry out an obscure though valuable job in

the most remote corners of the railways he has visited.

Each photograph is accompanied by an explanatory text in which, leaving on one side the technical and descriptive aspects of the question, the author relates his personal impressions of the journey.

To sum up, « *On the Old Lines* » will seem truly impassioned reporting to all those who appreciate the poetry of the « old railway ».

R. S.

MONTHLY BIBLIOGRAPHY OF RAILWAYS⁽¹⁾

PUBLISHED UNDER THE SUPERVISION OF

P. GHILAIN,

General Secretary of the Permanent Commission of the International Railway Congress Association.

(OCTOBER 1958)

[016. 385 (02)]

I. — BOOKS.

In French.

1958 656 .2

L'Année Ferroviaire 1958.

Paris (6^e) : Librairie Plon, 8, rue Garancière. Un volume (14 × 23 cm) de 208 pages avec 78 figures.

1958 531

DENIS-PAPIN.

Aide-Mémoire Dunod : Mécanique-Physique Générale. 6^e édition.

Paris : Dunod, éditeur. Un volume (10 × 15 cm) de 337 pages, avec 133 figures et un dépliant. (Prix : 480 fr.fr.)

1958 621 .3

DENIS-PAPIN.

Aide-Mémoire Dunod Electrotechnique Générale. 5^e édition.

Paris : Dunod, éditeur. Un volume (10 × 15 cm) de 180 pages, avec 242 figures. (Prix : 480 fr.fr.)

1958 62 (01)

LABOUREUR (M.).

Cours abrégé de résistance des matériaux et de stabilité des constructions.

Paris : Librairie Polytechnique Ch. Béranger, éditeur. Un volume (16 × 25 cm) de 324 pages, avec 315 figures. (Prix : 5 000 fr.fr.)

1958 385 (08) (675)

OFFICE D'EXPLOITATION DES TRANSPORTS COLONIAUX (OTRACO).

Rapport 1957.

Bruxelles, OTRACO, 101, avenue Louise. Une brochure (22 × 29 cm) de 54 pages, avec carte, tableaux graphiques et photos hors texte.

1958 621 .7

Le Travail des Métaux sans enlèvement de copeaux.

Numéro spécial (juin 1958) de *La Technique Moderne*. Paris : Dunod, éditeur, 92, rue Bonaparte. Un volume (24 × 32 cm) de 114 pages de texte, abondamment illustré. (Prix : 1 600 fr.fr.)

In German.

1957 621 .13

Dampflokomotivkunde.

Bd. 134 der Eisenbahn-Lehrbücherei. Hrsg. im Auftrag der Hauptverwaltung der Deutschen Bundesbahn durch die Arbeitsgemeinschaft für Ausbildungshilfsmittel.

Starnberg, Josef Keller Verlag, 628 Seiten DIN A5. (Preis Hln. : DM 19.80. Vorzugspreis für Eisenbahner : DM 13.20.)

1958 621 .13 & 625 .2

Elsners Taschenbuch für den maschinentechnischen Eisenbahndienst 1957. 16. Jahrgang.

Frankfurt-Berlin, Dr. Arthur Tetzlaff-Verlag. 440 Seiten mit zahlreichen Abbildungen und Tabellen, biegsam gebunden. (Preis, Ganzleinen : DM 6.—.)

1958 621 .116

FEIERER (R.).

Kesselspeisewasser-Technologie/Betriebsanalyse.

Berlin, Verlag Walter de Gruyter & Co. 194 Seiten, mit 35 z.T. farbigen Abbildungen. (Preis : DM 38.—.)

1957 656 .224

Der Öffentliche Personennahverkehr.

Herausgegeben von C. RISCH und F. LOIDEMANN. Berlin — Göttingen —, Heidelberg, Springer-Verlag. 463 Seiten, Din C5, 451 Abbildungen. (Preis : Ganzleinen, DM 67.50.)

1957 656

Schiene und Strasse 1957.

Herausgegeben von Staatssekretär Prof. Dr. h.c. Leo BRANDT.

Dortmund, Verkehrs- und Wirtschaftsverlag GmbH. 1957. 232 Seiten. (Preis : DM 8.90.)

In English.

1958 385 (061.4) (73) & 656 .25 (73)

Association of American Railroads. Signal section. Advance Notice. Vol. LV, No. 1.

Reports to be presented at the Fifty-Ninth Annual Meeting, Chicago, Ill., September 16, 17 and 18, 1958.

Published by the Signal Section A.A.R., 59 East Van Buren Street, Chicago 5, Ill. (No price stated.)

(1) The numbers placed over the title of each book are those of the decimal classification proposed by the Railway Congress conjointly with the Office Bibliographique International, of Brussels. (See « Bibliographical Decimal Classification as applied to Railway Science », by L. WEISSENBRUCH, in the number for November 1897, of the *Bulletin of the International Railway Congress*, p. 1509).

- 1958** **621 .131 .3 (42)**
British Transport publications. Locomotive performance and efficiency test bulletins :
 No. 1. — Western Region Hall class;
 No. 2. — Eastern and North Eastern Regions B1 class;
 No. 3. — London Midland Region class 4;
 No. 4. — British Railways standard class 4;
 No. 5. — British Railways standard class 7;
 No. 6. — British Railways standard class 5;
 No. 7. — W.D. freight locomotives;
 No. 8. — Eastern and North Eastern Regions V2 class;
 No. 10. — Southern Region Merchant Navy class;
 No. 15. — British Railways standard class 8;
 No. 16. — Southern Region 2 000 HP main line Diesel-Electric;
 No. 19. — English Electric 3 300 HP Diesel-Electric Deltic.

Obtainable from : British Transport Commission, Publicity Division, 222, Marylebone Road, London, N.W.1. (Price : 10 s. each Bulletin.)

- 1958** **651**
CANNING (R.G.).
Installing electronic data processing systems.
 New York : John Wiley. London : Chapman and Hall.
 One volume, 193 pages. (Price : £ 2.8 s.)

- 1958** **691**
EVANS (R.H.) and BENNETT (E.W.).
Pre-stressed concrete — theory and design.
 London : Chapman and Hall Ltd., 37, Essex Street, Strand, W.C.2. (Price : 60 s.)

[016. 385 (05)]

II. — PERIODICALS.

In French.

Bulletin de l'Association Suisse des Electriciens. (Zurich.)

- 1958** **621 .3**
 Bull. de l'Ass. Suisse des Electriciens, 21 juin, p. 576.
GADEN (D.). — Les divers modes d'application du réglage fréquence-puissance. (4 000 mots & fig.)

- 1958** **691**
 Bull. de l'Ass. Suisse des Electriciens, 21 juin, p. 585.
WÄLCHLI (O.). — Les essais de l'U.C.S. sur l'imprégnation des poteaux de bois. (3 000 mots, tableaux & fig.)

Bulletin des C.F.F. (Berne.)

- 1958** **656 .2 (494)**
 Bulletin des C.F.F., août, p. 118.
WICHSEER (M.O.). — La planification des travaux et de l'exploitation aux Chemins de fer fédéraux. (2 000 mots.)

- 1958** **385 (09 (54))**
Indian railways, 1956-57.
 One volume (8 1/4 in. × 5 1/4 in.) of 114 pages + 58 pages charts and statistical tables.
 Published by the Ministry of Railways, Railway Board, New Delhi (India). (No price quoted.)

- 1958** **691**
MORICE (P.B.) and COOLEY (E.H.).
Prestressed concrete.
 London : Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, W.C.2. (Price : 57 s. 6 d.)

- 1958** **385 (09 (42))**
NOCK (O.S.).
The Great Northern Railway.
 One volume (8 1/2 in. × 6 1/4 in.), 192 pages. Illustrated. Ian Allan Limited, Craven House, Hampton Court, Surrey. (Price : 30 s.)

- 1958** **691**
ALY AHMED RAAFAT.
Reinforced concrete in architecture.
 One volume, illustrated.
 Reinhold Publishing Corporation, 430 Park Avenue, New York 22, N.Y., U.S.A. (price : 15 dol.); and Chapman and Hall Limited, 37, Essex Street, London, W.C.2. (Price : 120 s.)

In Netherlands.

- 1958** **385 (08 (492))**
Jaarverslag 1957, N.V. Nederlandsche Spoorwegen.
 Utrecht, Nederlandsche Spoorwegen. 46 bladzijden (21 × 30 cm) met kaart en illustraties.

- 1958** **621 .33 (4)**
 Bulletin des C.F.F., août, p. 126.
Jonction des réseaux ferroviaires électrifiés d'Europe Occidentale — Genève — Lyon — Marseille. (1 000 mots & fig.)

Bulletin de la Société Belge des Electriciens. (Bruxelles.)

- 1958** **621 .31**
 Bulletin de la Soc. Belge des Electriciens, n° 2, p. 93.
DENIS (F.). — Le réglage automatique de la production dans les réseaux électriques. (6 000 mots & fig.)

- 1958** **621 .31 & 621 .33**
 Bulletin de la Soc. Belge des Electriciens, n° 2, p. 111.
RICHARDS (L.). — Problèmes posés par le raccordement des consommateurs à caractéristiques irrégulières, tels que fours à arc et traction monophasée. (4 000 mots & fig.)

Bulletin de la Société Française des Electriciens.
(Paris.)

1958 669 .1
Bulletin de la Société Française des Electriciens, mars,
p. 173.

DEFRANOUX (J.-M.). — Etude électrochimique de
la corrosion des aciers inoxydables. (2 700 mots & fig.)

1958 614 .8
Bulletin de la Société Française des Electriciens, mars,
p. 182.

BODIER (G.). — La protection contre les dangers
d'électrocution dans les installations électrothermiques.
(7 000 mots, tableaux & fig.)

Bulletin de la Société des Ingénieurs Civils
de France. (Paris.)

1958 624 (66)
Bulletin de la Soc. des Ingén. Civils de France, mars-
avril, p. 97.

ESQUILLAN (N.). — Le pont rail-route d'Abidjan
(Côte d'Ivoire). — 1. Exposé général — conception
de l'ouvrage. (7 000 mots & fig.)

1958 656 .1 & 656 .2
Bulletin de la Soc. des Ingén. Civils de France, mars-
avril, p. 130.

GUIBERT (R.). — Réalisations actuelles et perspec-
tives d'avenir du transport mixte par rail et par route.
(9 000 mots & fig.)

Bulletin Technique de la Suisse Romande.
(Lausanne.)

1958 621 .31
Bull. techn. de la Suisse Romande, 21 juin, p. 221.

FAVEZ (B.). — Aperçus sur une étude théorique
générale du réglage de la fréquence et de la puissance
d'échange des réseaux d'énergie électrique. (4 000 mots
& fig.)

1958 691
Bull. techn. de la Suisse Romande, 19 juillet, p. 249.
LAFUMA (H.). — Ciments Portland et ciments
spéciaux. (5 500 mots.)

1958 691
Bull. techn. de la Suisse Romande, 19 juillet, p. 255.
STUCKY (J.-P.). — Appréciation de la qualité du
béton. (4 000 mots & fig.)

Bulletin des Transports Internationaux
par Chemins de fer. (Berne.)

1958 656 (485)
Bull. des transp. intern. par ch. de fer, mai, p. 154.

L'évolution des divers modes de transport, leur struc-
ture et le problème de la coordination en Suède.
(2 000 mots.)

1958 385 .62 & 385 .63
Bulletin des transp. intern. par ch. de fer, juin, p. 175.
Extrait du rapport de gestion de l'Office central des
transports internationaux par chemin de fer pour l'année
1957. (200 mots.)

Bulletin de l'Union Internationale
des Chemins de Fer. (Paris.)

1958 625 .151
Bulletin de l'Union Internationale des Chemins de fer,
juin, p. 186.

Le réchauffage des aiguilles dans les pays européens
et aux Etats-Unis d'Amérique. (5 000 mots, tableaux
& fig.)

1958 385 (09 (3) & 385 .113 (3)
Bulletin de l'Union Internationale des Chemins de fer,
juin, p. 202.

Les Chemins de fer en 1957. (Cinquième Partie.)
(6 000 mots & tableaux.)

Chemins de Fer. (Paris.)

1958 625 .28 (44)
Chemins de fer, juillet-août, p. 89.

CAIRE (D.). — Les problèmes posés par la traction
des trains sur la ligne Marseille-Nice. (5 000 mots & fig.)

1958 625 .28 (460)
Chemins de fer, juillet-août, p. 101.

Baron VUILLET. — Espagne..., terre des contrastes.
(2 000 mots & fig.)

Electricité. (Paris.)

1958 537 .7
Electricité, avril, p. 161.

HEROU (R.). — Les étalons nationaux d'unités
électriques. (4 000 mots & fig.)

1958 621 .3 : 691
Electricité, avril, p. 177.

GENIN (G.). — Nouvelles applications des plastiques
dans l'industrie électrique. (3 000 mots & fig.)

Génie Civil. (Paris.)

1958 621 .33 (44)
Génie Civil, 15 juillet, p. 305.

PAPAUT (R.). — L'électrification en courant mono-
phasé 25 kV - 50 Hz de la ligne Paris-Lille. (4 000 mots
& fig.)

1958 721 .1
Génie Civil, 15 juillet, p. 317.

LOSSIER (H.). — La crise de confiance de la méca-
nique des sols. (2 500 mots.)

L'Industrie Nationale. (Paris.)

1958 669 .1
L'Industrie Nationale, n° 2, avril-juin, p. 3.

DAMIEN (R.). — Tendances actuelles dans la sidé-
rurgie. (9 000 mots & fig.)

Industries et Sciences.

(Rhode-Saint-Genève-lez-Bruxelles.)

1958 621 .33 (47)
Industries et Sciences, mars, p. 19.

STAROSKOLSKY (N.A.). — La traction électrique
haute fréquence sans contact dans les mines en U.R.S.S.
(1 500 mots & fig.)

L'Ingénieur. (Montréal.)

- 1958 691
L'Ingénieur, n° 174, p. 12.
CHAURET (E.). — Les réactions agrégat-ciment dans le béton. (3 000 mots, tableaux & fig.)

Revue Brown Boveri. (Baden.)

- 1958 621 .31
Revue Brown Boveri, janvier, p. 3.
Turboalternateurs de puissance limite. (7 000 mots & fig.)

- 1958 621 .31
Revue Brown Boveri, janvier, p. 29.
L'essai des transformateurs au moyen d'ondes de choc coupées. (8 000 mots & fig.)

- 1958 621 .31
Revue Brown Boveri, janvier, p. 44.
Convertisseurs à moyenne fréquence. (4 500 mots & fig.)

Revue Electricité-

Electrotechnique Générale. (Bruxelles.)

- 1958 621 .31
Revue Electricité-Electrotechnique Générale, n° 6, p. 153.
MORREN (L.). — Causes d'erreurs dans la mesure de la puissance. (7 000 mots & fig.)

Revue Générale des Chemins de fer. (Paris.)

- 1958 621 .431 .72 (44)
Revue Générale des Chemins de fer, juin, p. 305.
LAIBE (R.) & COADIC. — La dieselisation de la Région desservie par la S.N.C.F. entre la Loire et la Gironde. (3 000 mots & fig.)

- 1958 656 .213 (44)
Revue Générale des Chemins de fer, juin, p. 315.
BRIGAUX & CLER. — La reconstruction de la gare de Calais-Maritime. (1 600 mots & fig.)

- 1958 625 .13 (44)
Revue Générale des Chemins de fer, juin, p. 323.
LECOUILLARD. — Mise au gabarit international du Tunnel de Bréval. Ligne de Paris à Cherbourg (Région Ouest de la S.N.C.F.). (2 000 mots & fig.)

- 1958 625 .26 (44)
Revue Générale des Chemins de fer, juin, p. 332.
CARLIER & COTTIGNIES. — L'organisation des chantiers par la méthode des temps élémentaires. La réparation des essieux de wagons aux Ateliers de Tergnier de la Région du Nord de la S.N.C.F. (1 000 mots & fig.)

- 1958 656 .222 .1
Revue Générale des Chemins de fer, juin, p. 342.
Les vitesses moyennes des trains de voyageurs dans les différents pays. (1 200 mots & tableaux.)

- 1958 656 .25 (44)
Revue Générale des Chemins de fer, juillet-août, p. 361.
WALTER (M.). — Le développement des installations de sécurité de la S.N.C.F. au cours des vingt dernières années. (5 000 mots & fig.)

- 1958 625 .245 (44)
Revue Générale des Chemins de fer, juillet-août, p. 400.
Un nouveau wagon à 4 essieux indépendants pour le transport de lingots chauds. (1 500 mots & fig.)

- 1958 62 (01 & 624 (0
Revue Générale des Chemins de fer, juillet-août, p. 406.
CASSÉ (M.). — La détermination des effets dynamiques dans les ponts. (1 700 mots & fig.)

- 1958 621 .33 (44)
Revue Générale des Chemins de fer, juillet-août, p. 419.
L'électrification de la ligne Paris-Lille. (800 mots & fig.)

- 1958 385 .1 (73)
Revue Générale des Chemins de fer, juillet-août, p. 423.
Les chemins de fer des Etats-Unis d'Amérique en 1957. (1 200 mots & fig.)

Revue Générale de Mécanique. (Paris.)

- 1958 691
Revue Générale de Mécanique, avril, p. 207.
MOREAU de BALASY (F.). — Les matériaux barrière et les déshydratants appliqués à la protection de matériels, machines et pièces détachées. (1 000 mots & fig.)

- 1958 621 .9
Revue Générale de Mécanique, avril, p. 227.
WEIL, PÉLLISSIER & HESSE. — Les appareils de métrologie à la 5^e Exposition Européenne de la Machine-Outil, à Hanovre, 15-24 septembre 1957. (1 500 mots & fig.)

- 1958 621 .9
Revue Générale de Mécanique, avril, p. 244.
Abbé CAYÈRE. — Recherches expérimentales sur le contrôle opératoire. Contrôle opératoire pendant les opérations de rectification cylindrique. (2 500 mots & fig.)

La Technique Moderne. (Paris.)

- 1958 625 .143 .3
La Technique Moderne, juillet, p. 327.
ROUSSE (R.). — Obligation et efficacité d'un meulage des rails atteints d'usure ondulatoire. (2 500 mots & fig.)

Les Transports Publics. (Berne.)

- 1958 656 .23 (494)
Les Transports Publics, juillet, p. 3.
HALTINER (H.). — Le niveau tarifaire des Chemins de fer suisses. (2 800 mots.)

Travaux. (Paris.)

- 1958 721 .9 (44)
Travaux, juillet, p. 543.
PIERRE (B.). — Les cintres en charpente métallique et béton armé associés du pont aval de Revin. (4 000 mots & fig.)

1958 624 .2
Travaux, juillet, p. 555.
GAUSSENS (J.). — Réseaux orthogonaux plans et courbes de poutres et entretoises. Application du calcul matriciel à l'étude des déformations. (3 000 mots & fig.)

La Vie du Rail. (Paris.)

1958 625 .15 (44)
La Vie du Rail, 22 juin, p. 7.

FORCE (G.). — Une visite à la S.E.I., Société de Constructions et d'Embranchements Industriels. (2 500 mots & fig.)

1958 625 .144 (44)
La Vie du Rail, 22 juin, p. 19.

Le déchargement en ligne des barres longues sur un chantier du Sud-Est. (600 mots & fig.)

1958 625 .1 (44)
La Vie du Rail, 6 juillet, p. 3.

Travaux préliminaires à l'électrification Est-Paris dans la Région parisienne. Relevage pour mise au gabarit « électrification » du Pont de la Folie à Noisy-le-Sec. (1 000 mots & fig.)

1958 625 .232 (460)
La Vie du Rail, 13 juillet, p. 8.
CABRERA (J.B.). — Nouvelles voitures 1^{re} classe — cafeteria. (800 mots & fig.)

1958 621 .132 .8 (47)
La Vie du Rail, 13 juillet, p. 10.
Equipement d'une locomotive pour marcher au gaz butane-propane. (500 mots & fig.)

In German.

Archiv für Eisenbahnwesen. (Berlin.)

1958 385 (73)
Archiv für Eisenbahnwesen, Heft 2, S. 127.
WEHDE-TEXTOR (O.). — Die Eisenbahnen der Vereinigten Staaten von Amerika im zweiten Weltkrieg 1939 bis 1945. (12 000 Wörter, Tafeln & Abb.)

1958 385 (09) (485)
Archiv für Eisenbahnwesen, Heft 2, S. 152.
GÜNTHER (A.). — Entwicklung und heutige Lage der Schwedischen Staatseisenbahnen. (11 000 Wörter, Tafeln & Abb.)

Die Bundesbahn. (Darmstadt und Köln.)

1958 385 (06) .4 (493)
Die Bundesbahn, Nr. 10, Mai, S. 499.
WENDLER (K.). — Die UIC unter dem fünfzackigen Stern von Brüssel. (5 000 Wörter & Abb.)

1958 656 .2 (4)
Die Bundesbahn, Nr. 10, Mai, S. 510.
MAIER-SCHOEN (A.). — Die Produktivität der Eisenbahnen. (4 000 Wörter & Abb.)

1958 656 .225 (43)
Die Bundesbahn, Nr. 10, Mai, S. 522.
ZILLER (H.). — Neues Richtpunktverfahren für Eilgutwagenladungen bei der Deutschen Reichsbahn (4 000 Wörter & Abb.)

1958 621 .33 (43)
Die Bundesbahn, Nr. 11, Juni, S. 553.
KOTZOTT (K.). — Die Elektrifizierung der S-Bahn-Strecke Hamburg Hbf-Bergedorf. (4 000 Wörter & Abb.)

1958 656 .2 (43)
Die Bundesbahn, Nr. 12, S. 619.
DENSCH (H.). — Die DB im Verkehr der Eisen schaffenden Industrie des Ruhrgebietes. (7 000 Wörter & Abb.)

1958 656 .2 (43)
Die Bundesbahn, Nr. 12, S. 636.
KEGEL (S.). — Ruhrsiedlungsverband und Bundesbahn. (7 000 Wörter & Abb.)

1958 656 .222 .5
Die Bundesbahn, Nr. 12, S. 647.
DUSSE (H.). — Nahverkehrsprobleme im Zusammen spiel der Verkehrsträger. (5 000 Wörter & Abb.)

1958 656 .222 .5 (43)
Die Bundesbahn, Nr. 12, S. 655.
LINDEN (W.). — Die Zusammenarbeit des Verkehrsverbandes «Industriebezirk » auf dem Gebiet des Per sonenzugfahrplanes mit der Deutschen Bundesbahn. (6 000 Wörter.)

1958 625 .122
Die Bundesbahn, Nr. 12, S. 681.
POHL (L.). — Bergsenkungen. (6 000 Wörter & Abb.)

1958 621 .33 (43)
Die Bundesbahn, Nr. 12, S. 695.
Weitere 400 Kilometer DB-Strecken wurden elektri fiziert. (5 000 Wörter & Abb.)

Deutsche Eisenbahntechnik. (Berlin.)

1958 656 .2
Deutsche Eisenbahntechnik, Juni, S. 249.
BERNHARD (K.A.). — Vervollkommnung der Betriebsmethoden der Eisenbahnen. (4 000 Wörter, Tafeln & Abb.)

1958 625 .28
Deutsche Eisenbahntechnik, Juni, S. 253.
GARNIK (W.A.). — Technischer Fortschritt im Zugförderungswesen im Laufe von 40 Jahren. (5 000 Wörter & Abb.)

1958 625 .14
Deutsche Eisenbahntechnik, Juni, S. 263.
Entwicklung der Streckenwirtschaft im Laufe von 40 Jahren. (3 500 Wörter & Abb.)

1958 656 .2 (43)
Deutsche Eisenbahntechnik, Juni, S. 267.
SEMPER (W.). — Probleme des Betriebs- und Ver kehrsdienstes der Deutschen Reichsbahn. (6 500 Wörter & Abb.)

1958 656 .223 (43)
Deutsche Eisenbahntechnik, Juni, S. 276.
CRUSE (H.). — **Die Organisation und die wichtigsten Probleme in der Maschinenwirtschaft der Deutschen Reichsbahn.** (4 500 Wörter & Abb.)

1958 625 .1 (43) & 625 .2 (43)
Deutsche Eisenbahntechnik, Juni, S. 283.
GREVESMÜHL (A.). — **Forschungs- und Entwicklungsarbeit** bei der Eisenbahn der Deutschen Demokratischen Republik. (4 500 Wörter & Abb.)

1958 625 .2 (43)
Deutsche Eisenbahntechnik, Juni, S. 288.
Organisation und Aufgaben der Wagenwirtschaft bei der Deutschen Reichsbahn. (7 000 Wörter & Abb.)

1958 625 .1 (43)
Deutsche Eisenbahntechnik, Juni, S. 298.
FREITAG. — **Aufgaben der Hauptverwaltung der Bahnanlagen** der Deutschen Reichsbahn. (5 000 Wörter & Abb.)

1958 656 .25 (43)
Deutsche Eisenbahntechnik, Juni, S. 305.
DUNGER (R.). — **Das Sicherungs- und Fernmeldewesen** der Deutschen Reichsbahn. (4 500 Wörter & Abb.)

1958 625 .26 (43)
Deutsche Eisenbahntechnik, Juni, S. 311.
NIED (F.). — **Die Sicherung des technischen Fortschrittes in den Reichsbahnausbesserungswerken.** (5 000 Wörter & Abb.)

Der Eisenbahningenieur. (Frankfurt-am-Main.)

1958 656 .2
Der Eisenbahningenieur, Juni, S. 157.
BERG (R.). — **Die Eisenbahnen an der Schwelle einer neuen Ära.** (5 000 Wörter.)

1958 725 .31 (43)
Der Eisenbahningenieur, Juni, S. 164.
SCHMITT (O.). — **Der Wiederaufbau und die Neugestaltung des Empfangsgebäudes Hauptbahnhof Köln.** (2 000 Wörter & Abb.)

1958 651 (43)
Der Eisenbahningenieur, Juni, S. 171.
ZITZLSPERGER (A.). — **Automatisierung im Vermessungswesen** der Deutschen Bundesbahn. (2 000 Wörter & Abb.)

1958 625 .151
Der Eisenbahningenieur, Juni, S. 174.
WARNICK (A.). — **Vereinfachte Berechnung der Weichenhöhenpläne** bei Weichen in Überhöhungsrampen. (200 Wörter & Abb.)

1958 624
Der Eisenbahningenieur, Juni, S. 177.
ZANOSKAR (W.). — **Einpressearbeiten** — Durchführung und Abrechnung bei den Österreichischen Bundesbahnen. (500 Wörter.)

1958 625 .151
Der Eisenbahningenieur, Juli, S. 190.
MÜNCH (W.). — **Neuerungen im Weichenbau.** (4 000 Wörter & Abb.)

1958 625 .142 .2 (436)
Der Eisenbahningenieur, Juli, S. 201.
SCHUBERT (E.). — **Die Verwendung der Holzschwellen** bei den Österreichischen Bundesbahnen (ÖBB). (2 000 Wörter & Abb.)

1958 656 .254
Der Eisenbahningenieur, Juli, S. 205.
MÜLLER (H.). — **Die Sicherung der Bahnübergänge** bei den französischen, niederländischen und schweizerischen Eisenbahnen. (4 000 Wörter & Abb.)

1958 621 .138 .5
Der Eisenbahningenieur, Juli, S. 211.
Van de LOO (K.). — **Elektronisch messende Auswuchtmaschinen** für den Einsatz in Bahn-Betriebswerkstätten. (1 300 Wörter & Abb.)

Elektrische Bahnen. (München.)

1958 621 .335
Elektrische Bahnen, Heft 6, S. 121.
BRAUN (H.). — **Regeleinrichtungen für die Ladung von Akkumulatorentriebwagen** mit Hilfe gittergesteuerter Gleichrichter. (4 000 Wörter & Abb.)

1958 621 .335
Elektrische Bahnen, Heft 6, S. 128.
KORB (F.). — **Stromrichteranlagen** für selbsttätige Ladung von Akkumulatorentriebwagen. (2 000 Wörter & Abb.)

1958 625 .258
Elektrische Bahnen, Heft 6, S. 133.
LANGKAU (H.) und BÜCHELE (H.). — **Die Magnetkraft von Magnetschienenbremsen** und deren Überwachung durch Magnetfluss-Messungen. (3 000 Wörter & Abb.)

1958 621 .335 (68)
Elektrische Bahnen, Heft 6, S. 138.
HAHN (O.H.). — **Nutzbremsung von 3 000 Volt-Lokomotiven** in Südafrika. (3 000 Wörter & Abb.)

Elektrotechnik und Maschinenbau. (Wien.)

1958 621 .31
Elektrotechnik und Maschinenbau, 15. Juni, S. 389.
SCHÖN (R.). — **Die günstigste Kurzschlussspannung einer Strombegrenzungsdrosselspule.** (5 000 Wörter & Abb.)

1958 621 .31
Elektrotechnik und Maschinenbau, 15. Juli, S. 433.
VOGT (St.). — **Trockengleichrichter**, insbesondere Selengleichrichter. (1 400 Wörter & Abb.)

1958 621 .31
Elektrotechnik und Maschinenbau, 15. Juli, S. 435.
AICHHOLZ (H.). — **Ein Einankerumformer** zur Erzeugung von Mittelfrequenz. (4 000 Wörter & Abb.)

E.T.Z. (Elektrotechnische Zeitschrift. (Berlin.)

1958 621 .31
E.T.Z., 21. Juni, S. 229.
SAUER (J.) & WERNER (O.). — Überwachung von Stromrichteranlagen mit Transistor-Störmeldern. (1 500 Wörter & Abb.)

1958 691
E.T.Z., 21. Juni, S. 233.
BESS (O.). — Elektrischer Korrosionsschutz von Stahlkonstruktionen in Wasser und Boden. (1 500 Wörter & Abb.)

1958 621 .31
E.T.Z., 21. Juni, S. 237.
METZGER (F.). — Der Einfluss der Kurzschluss-Fortschaltung auf die elektrischen Antriebe. (1 200 Wörter & Abb.)

1958 621 .31
E.T.Z., 21. Juli, S. 261.
PODSZEK (H.K.). — Fernwirktechnik in Energieversorgungsanlagen. (5 200 Wörter & Abb.)

E.T.R. Eisenbahntechnische Rundschau.
(Köln-Darmstadt.)

1958 625 .282 (43)
E.T.R., Juni, S. 221.
FRIEDRICH (K.). — Die Planung für das Diesel-lokomotiv-Typenprogramm der Deutschen Bundesbahn. (6 000 Wörter & Abb.)

1958 721 .1
E.T.R., Juni, S. 234.
PETERMANN (H.). — Die Entwicklung der Boden-mechanik und ihrer Anwendung im Bauwesen. (6 000 Wörter.)

1958 621 .132 .8 (68)
E.T.R., Juni, S. 241.
ROOSEN (R.) und HANY (H.). — Henschel-Kondens-lokomotive Class 25 der Südafrikanischen Bahnen. (6 500 Wörter & Abb.)

1958 624 .1 (43)
E.T.R., Juni, S. 250.
SÜSS (W.) und von SOOS (P.). — Gründungspro-bleme und ihre Lösung beim Bau der Reischenhart-brücke. (6 000 Wörter & Abb.)

1958 725 .31 (43)
E.T.R., Juni, S. 260.
von REDEN (W.). — Das neue Empfangsgebäude des Hauptbahnhofs Köln. (4 500 Wörter & Abb.)

Europa Verkehr. (Darmstadt.)

1958 656 .222 .5 (4)
Europa Verkehr, 15-7-1958, S. 82.
RENON (P.). — Le soixante-quinzième anniversaire de l'« Orient Express ». (3 000 Wörter & Abb.)

Glaser's Annalen. (Berlin.)

1958 621 .134 .3
Glaser's Annalen, Mai, S. 147.
RÜGGERBERG (G.). — Mechanische Umsteuerung von Dampflokomotiven. (3 000 Wörter & Abb.)

1958 621 .138 (43)
Glaser's Annalen, Juni, S. 183.
THIEL (O.). — Die Entwicklung des Motorenprüffeldes im Bundesbahn-Ausbesserungswerk Nürnberg. (6 000 Wörter & Abb.)

1958 625 .285
Glaser's Annalen, Juni, S. 194.
CRAMER (E.). — Ein Salon-Dieseltriebwagen mit Klimaanlage. (3 000 Wörter & Abb.)

1958 625 .2
Glaser's Annalen, Juni, S. 201.
ALTEN (H.). — Über die Verwendung nichtrostenden Stahls bei Eisenbahnfahrzeugen an Hand des Doppel-trieb-wagens der Firma Linke-Hofmann-Busch GmbH. (2 000 Wörter & Abb.)

1958 625 .285 (435 .9)
Glaser's Annalen, Juni, S. 205.
Zweiteiliger dieselhydraulischer Triebwagen mittlerer Leistung der Vereinigten Westdeutschen Wagenfabriken A.G. für die Luxemburgische Staatsbahn. (3 000 Wörter & Abb.)

1958 625 .28 (436)
Glaser's Annalen, Juni, S. 211.
KARNER (F.) & RATH (H.). — Von der Bavaria zur ML 2 200 C'C'. Die Versuchsfahrten mit der Diesellok ML 2 200 C'C' am Semmering im Herbst 1957. (3 000 Wörter & Abb.)

1958 621 .33 (47 .1)
Glaser's Annalen, Juni, S. 218.
Finland plant Elektrifizierung von Strecken mit 50 Hz. (300 Wörter & Karte.)

1958 625 .28
Glaser's Annalen, Juni, S. 218.
Analytische Untersuchung des wirtschaftlichen Vorteiles beim freien Auslauf von Eisenbahn-Triebfahrzeugen. (1 500 Wörter.)

Internationales Archiv für Verkehrswesen.
(Mainz.)

1958 625 .2
Internationales Archiv für Verkehrswesen, Nr. 9/10, Maiheft, S. 177.
HEUER (G.). — Anwendungsmöglichkeiten des Leitschienenprinzips bei der Eisenbahn. (2 000 Wörter & Abb.)

1958 385 .14
Internationales Archiv für Verkehrswesen, Nr. 11, 1. Juniheft, S. 209.
OTTMANN (K.). — Transportpreise und Geldentwertung. (3 000 Wörter.)

1958 656 .211 .5
Schweizerisches Archiv für Verkehrswissenschaft und Verkehrspolitik, Nr. 2, S. 217.
HEUER (G.). — Die Zusammenarbeit im Personen-
verkehr. (1 600 Wörter.)

Leichtbau der Verkehrsfahrzeuge. (Köln.)

1958 625 .212
Leichtbau der Verkehrsfahrzeuge, Mai-Juni, S. 94.
KOTZSCHKE (P.) & KÖNIG (H.). — Die Ent-
wicklung von Leichtmetall-Radscheiben für Radsätze von
Serienschnellfahrzeugen. (4 500 Wörter & Abb.)

1958 625 .212
Leichtbau der Verkehrsfahrzeuge, Mai-Juni, S. 101.
RAUTENBERG (W.). — Statische und dynamische
Dehnungs-Spannungsmessungen an Eisenbahnradern.
(7 000 Wörter & Abb.)

1958 625 .2 (485)
Leichtbau der Verkehrsfahrzeuge, Mai-Juni, S. 116.
Leichtbau der Verkehrsfahrzeuge in Schweden. (4 500
Wörter & Abb.)

Der Öffentliche Verkehr. (Berlin.)

1958 656 .23 (494)
Der Öffentliche Verkehr, Juli, S. 3.
HALTNER (H.). — Das Tarifniveau der Schweizer-
ischen Eisenbahnen. (1 500 Wörter.)

1958 621 .335 (494)
Der Öffentliche Verkehr, Juli, S. 6.
BÄCHTIGER (A.). — Die 2 400 PS B.B.B.-Loko-
motiven der Rhätischen Bahn. (1 200 Wörter & Abb.)

1958 656 .2 (494)
Der Öffentliche Verkehr, August, S. 12.
Die Bau- und Betriebsplanung der Bundesbahnen.
(2 500 Wörter.)

Schweizerisches Archiv für Verkehrswissenschaft und Verkehrspolitik. (Zürich.)

1958 656 .1 (436)
Schweizerisches Archiv für Verkehrswissenschaft und
Verkehrspolitik, Nr. 2, S. 173.
MRAVLÄG (G.). — Der Kraftwagendienst der
Österreichischen Bundesbahnen. Seine Aufgaben und
Leistungen. (2 500 Wörter & Tabellen.)

Siemens-Zeitschrift. (Erlangen.)

1958 621 .3 : 651
Siemens-Zeitschrift, März, S. 142.
KAUFMANN (H.). — Der Siemens-Digital-Rechner
2002. (2 000 Wörter & Abb.)

Signal und Draht. (Frankfurt-Main.)

1958 656 .25
Signal und Draht, Juni, S. 105.
LEONHARD (E.). — Die Blinklichtanlagen mit
Lokführerüberwachungssignalen der Bauform Pintsch
(Lo 1.57). (4 500 Wörter, Tafeln & Abb.)

1958 656 .254 (43)
Signal und Draht, Juni, S. 112.
LEITENBERGER (W.) & ROSA (F.). — Vollauto-
matische Sammelschalteneinrichtung für die Fernschreib-
anlagen der Deutschen Bundesbahn. (2 000 Wörter
& Abb.)

1958 656 .25
Signal und Draht, Juli, S. 121.
LEONHARD (E.). — Die Blinklichtanlagen mit Lok-
führerüberwachungssignalen der Bauform Pintsch (Lo
1.57). Fortsetzung. (8 000 Wörter & Abb.)

Wissenschaftliche Zeitschrift der Hochschule für Verkehrswesen Dresden. (Dresden.)

1957 624 .6
Wissenschaftliche Zeitschrift der Hochschule für Ver-
kehrswesen Dresden, Heft 4, S. 561.
BIENERT (G.). — Über die Beurteilung der Trag-
fähigkeit massiver Brückengewölbe. (6 000 Wörter,
Tafel & Abb.)

1957 624
Wissenschaftliche Zeitschrift der Hochschule für Ver-
kehrswesen Dresden, Heft 4, S. 621.
GRABNER (H.). — Die Hochbauaufgaben auf dem
Verkehrssektor. (1 800 Wörter & Abb.)

1957 656 .235
Wissenschaftliche Zeitschrift der Hochschule für Ver-
kehrswesen Dresden, Heft 5, S. 715.
KEIL (H.). — Unterschiedliche Preisgestaltung in den
Gütertarifen der Eisenbahnen unter besonderer Berück-
sichtigung der Werttarifizierung. (7 000 Wörter & Abb.)

1957 656 .2 (43)
Wissenschaftliche Zeitschrift der Hochschule für Ver-
kehrswesen Dresden, Heft 5, S. 739.
HOFMANN (K.). — Zum Problem der Betriebs-
einheit und der Bruttoproduktion bei der Deutschen
Reichsbahn. (5 000 Wörter & Tafeln.)

In English.

Electrical Engineering. (New York.)

1958 621 .333
Electrical Engineering, July, p. 585.
WIDELL (B.A.). — Railway traction equipment
ventilating systems. (1 000 words.)

1958 621 .3 & 651
Electrical Engineering, July, p. 592.
GOLDMAN (R.N.). — DDA — What is it? (2 000
words & figs.)

The Engineer. (London.)

1958 625 (42)
The Engineer, March 28, p. 464.
Railway modernisation at Barking. (2 000 words
& figs.)

- 1958 625 .245
The Engineer, April 4, p. 517.
Heavy transporter wagon. (500 words & figs.)
- 1958 621 .333 (42)
The Engineer, April 11, p. 528.
Silicone insulation for traction motors. (2 400 words & figs.)
- 1958 621 .9 (42) & 625 .142 (42)
The Engineer, April 25, p. 628.
Automatic production machine for railway sleepers. (1 300 words & figs.)
- Engineering. (London.)
- 1958 625 .214
Engineering, May 23, p. 660.
SCOTT (D.). — Lubricants at higher temperatures. Assessing the effects on ball bearings failures. (3 000 words, tables & figs.)
- Far East Trade. (London.)
- 1958 625 .28 (42)
Far East Trade, July, p. 919.
HOLLOWAY (T.). — World demand for latest U.K. rolling stock. (4 200 words & figs.)
- 1958 625 .617
Far East Trade, July, p. 925.
Containers cut transport costs. (1 400 words & figs.)
- Gas & Oil power. (London.)
- 1958 621 .431 .72 (42)
Gas & Oil power, July, p. 171.
Success of diesel traction. (900 words & figs.)
- Indian Railways. (New Delhi.)
- 1958 625 .214
Indian Railways, June, p. 353.
PATERSON (P.C.). — The lubrication of railway journal roller bearings. (8 000 words & figs.)
- 1958 621 .431 .72 (73)
Indian Railways, June, p. 363.
BEVAN (G.T.). — Railway dieselisation experiences in U.S.A. (1 500 words & figs.)
- Proceedings, The Institution of Civil Engineers. (London.)
- 1958 624 .0
Proceedings, The Institution of Civil Engineers, Vol. 10, p. 321.
LICHTFOOT (E.). — A moment-distribution method for vierendeel bents and girders with inclined chords. (32 pages & figs.)
- The Proceedings of the Institution of Electrical Engineers. (London.)
- 1958 621 .337 .1
The Proceedings of the Institution of Electrical Engineers, April, p. 152.
SYMES (H.E.J.). — The principal characteristics and general analysis of a new epicyclic drive for electric locomotives. (4 500 words & figs.)

- Journal-Institution of Engineers, Australia. (Sydney.)
- 1958 624 (943)
Journal-Institution of Engineers, Australia, June, p. 169.
KINDLER (J.E.). — Burdekin bridge superstructure. (13 000 words & figs.)
- 1958 691
Journal-Institution of Engineers, Australia, June, p. 185.
BUTCHER (W.S.). — The evaluation of hardened concrete. (5 000 words.)
- The Locomotive. (London.)
- 1958 621 .131 .3 (42)
The Locomotive, July, p. 122.
Improvement of steaming. *Part two.* (1 600 words & figs.)
- 1958 621 .431 .72 (73)
The Locomotive, July, p. 125.
« RDC » diesel railcar operation on the Boston & Maine R.R. (1 100 words & figs.)
- 1958 621 .431 .72 (43)
The Locomotive, July, p. 127.
Diesel locomotive development on the German Federal Railway. (600 words & figs.)
- 1958 621 .335 (45)
The Locomotive, July, p. 128.
The Italian State Railways series D 341 diesel-electric Bo-Bo. (500 words & figs.)
- Mechanical Engineering (New York.)
- 1958 62
Mechanical Engineering, May, p. 66.
HARVEY (A.). — Management and engineering in the age of automation. (3 000 words.)
- 1958 625 .213
Mechanical Engineering, July, p. 39.
RADKE (A.O.). — Vehicle vibration. (2 200 words & figs.)
- Modern Railroads. (Chicago.)
- 1958 656 .2 (73)
Modern Railroads, May, p. 48.
History in the making. — Following a drastic reorganization in 1946, the modern Seaboard today is at its financial and physical peak. (1 800 words & figs & map.)
- 1958 621 .431 .72 (73)
Modern Railroads, May, p. 77.
SAL holds tight rein on Diesels. (1 400 words & figs.)
- 1958 625 .24 (73)
Modern Railroads, May, p. 85.
Big increase in freight cars. — To pace dynamic south-east, SAL has increased freight car fleet almost 50 percent since 1946. (1 200 words & figs.)
- 1958 625 .172 (73)
Modern Railroads, May, p. 109.
Seaboard track ranks with the best. (600 words & figs.)

1958 625 .172 (73)
Modern Railroads, May, p. 117.
Specialised gangs maintain track. (2 000 words & figs.)

Modern Transport. (London.)

1958 621 .33
Modern Transport, May 31, p. 3.
Some specialised rapid transit systems. For high-speed access to airports and interurban and urban operation. (2 500 words & figs.)

1958 621 .431 .72 (41)
Modern Transport, May 31, p. 13.
Railways in Ireland. A still extensive network. (1 100 words & figs.)

1958 656 .2 (42)
Modern Transport, June 7, p. 3.
Sir Brian ROBERTSON. — **The organisation of transport.** — Some examples and conclusions. (2 300 words.)

1958 621 .431 .72 (41)
Modern Transport, June 7, p. 5.
COURTNEY (T.C.). — **Diesel traction. The change-over on Irish Railways.** (3 600 words & tables.)

The Oil Engine. (London.)

1958 621 .431 .72 (42)
The Oil Engine, May, p. 18.
High-powered locomotives introduced. (2 000 words & figs.)

1958 621 .431 .72 (42)
The Oil Engine, June, p. 42.
Performance of Diesel-hydraulic locomotives. (1 000 words & figs.)

1958 621 .431 .72 (42)
The Oil Engine, June, p. 45.
British Railways second type of railbus. (500 words & figs.)

Railway Engineering. (Cape Town.)

1958 621 .38 .5 (68)
Railway Engineering, April, p. 29.
Huge mechanical workshops at Koedoespoort are largest and most modern in Africa. (5 000 words & figs.)

1958 621 .432 .72 (42)
Railway Engineering, April, p. 49.
DAY (J.R.). — **Diesel locomotives could be called the main successor to steam on the world's railways.** (1 300 words & figs.)

1958 621 .338 (68)
Railway Engineering, May, p. 25.
New lightweight electric coaches for S.A.R.'s reef suburban services. (6 000 words & figs.)

The Railway Gazette. (London.)

1958 621 .333 (42)
The Railway Gazette, April 11, p. 424.
Silicones in traction motor insulation. (3 000 words & figs.)

1958 621 .33 (83)
The Railway Gazette, April 11, p. 427.
Main-line electrification in Chile. (900 words & figs.)

1958 621 .431 .72 (42)
The Railway Gazette, June 6, p. 649.
Changeover to Diesel traction in Ireland. (2 400 words & tables.)

1958 656 .2 (42)
The Railway Gazette, June 6, p. 651.
The organisation of transport. (1 000 words.)

1958 621 .33 (52)
The Railway Gazette, June 6, p. 657.
Japanese high-speed multiple-unit stock. (500 words & figs.)

1958 621 .33 (44)
The Railway Gazette, June 6, p. 659.
Further A.C. electrification in France. (900 words & figs.)

1958 621 .335
The Railway Gazette, June 13, p. 687.
Cardan drive with plate spring couplings. (700 words & figs.)

1958 656 .28 (42)
The Railway Gazette, June 20, p. 722.
Ministry of Transport accident report. (1 200 words.)

1958 621 .431 .72 (45)
The Railway Gazette, June 27, p. 743.
Large Italian Diesel-locomotive. (200 words & figs.)

1958 625 .617 (42)
The Railway Gazette, June 27, p. 744.
Large-scale handling of smalls traffic. (250 words & figs.)

Diesel Railway Traction. (London.)

1958 621 .431 .72 & 625 .216
Diesel Railway Traction, May, p. 185.
Flexible non-metallic couplings. (1 500 words & figs.)

1958 621 .431 .72 (71)
Diesel Railway Traction, May, p. 188.
One-man operation. (4 300 words & figs.)

1958 621 .431 .72 (41)
Diesel Railway Traction, May, p. 196.
Schneider - S.C.G. hydraulic transmission. Some characteristics of the sets installed in the Ulster railcars. (320 words & chart.)

1958 621 .431 .72 (52)
Diesel Railway Traction, May, p. 201.
Japanese Diesel-hydraulic locomotives. (1 800 words & figs.)

1958 621 .431 .72 (47)
Diesel Railway Traction, May, p. 204.
Running of Diesel-electric locomotives. (800 words & charts.)

1958 621 .431 .72 (42)

Diesel Railway Traction, June, p. 211.

Large Diesel-electric locomotives, B.R. (1 500 words & figs.)

1958 621 .431 .72 (45)

Diesel Railway Traction, June, p. 215.

Diesel traction in Sardinia. (3 600 words & figs.)

1958 621 .431 .72 (47)

Diesel Railway Traction, June, p. 222.

Recent Diesel developments, U.S.S.R. (1 600 words & figs.)

Railway Locomotives and Cars. (New York.)

1958 621 .431 .72 (73)

Railway locomotives and cars, May, p. 32.

Electrostatic precipitator cleans engine air. (1 400 words & figs.)

1958 625 .214

Railway locomotives and cars, May, p. 40.

What next for solid bearings? (1 000 words & figs.)

Railway Track and Structures. (Chicago.)

1958 625 .143 .3 (73)

Railway Track and Structures, May, p. 23.

Engine burns... What railroads are doing about them. (3 500 words & figs.)

1958 625 .143 .3

Railway Track and Structures, May, p. 31.

Tests relate shelly rail to flow of metal under traffic. (500 words & figs.)

In Spanish.

Ferrocarriles y Tranvias. (Madrid.)

1958 656 .23

Ferrocarriles y Tranvias, n° 279, p. 300.

SANCHEZ GAMBORINO (F.M.). — La igualdad de tratamiento en las tarifas ferroviarias. (3 000 palabras.)

1958 625 .23 (44)

Ferrocarriles y Tranvias, n° 279, p. 306 & 311.

BOUILLOUD (Ph.). — El coche « pendular ». (2 000 palabras & fig.)

ARON (R.). — La comodidad del viajero y el coche « pendular ». (600 palabras.)

Revista de Ciencia Aplicada. (Madrid.)

1958 691

Revista de Ciencia Aplicada, mayo-junio, p. 201.

CALLEJA CARRETE (J.). — El cloruro cálcico como acelerador en la prefabricación del hormigón. (3 000 palabras, tablas & fig.)

1958 669

Revista de Ciencia Aplicada, mayo-junio, p. 222.

SERRA (M.). — Consideraciones experimentales sobre un nuevo proceso de protección metálica. (4 000 palabras & fig.)

In Italian.

Giornale del Genio Civile. (Roma.)

1958 624 .2

Giornale del Genio Civile, marzo-aprile, p. 179.

ZANABONI (O.). — Espressione mediante serie di tipo trigonometrico della deformata delle travi semplicemente inflesse e comunque vincolate. (5 000 parole.)

1958 624

Giornale del Genio Civile, marzo-aprile, p. 237.

LA TEGOLA (A.). — Sulla stabilità dell'equilibrio elastico nelle lastre piane. (3 000 parole & fig.)

Ingegneria Ferroviaria. (Roma.)

1958 656

Ingegneria Ferroviaria, maggio, p. 423.

LE VERT (P.). — Riflessioni sulla nozione di servizio pubblico e sulla perequazione tariffaria nei trasporti. (3 000 parole.)

1958 385 .11 (45)

Ingegneria Ferroviaria, maggio, p. 428.

TROTTA (G.). — L'equilibrio finanziario globale dell' esercizio ferroviario statale in cinquantuno anni di vita. (3 000 parole & tabelle.)

1958 656 .2 (45)

Ingegneria Ferroviaria, maggio, p. 466.

FINZI (V.). — Relazioni umane nelle F.S. (5 000 parole.)

1958 621 .33 (45)

Ingegneria Ferroviaria, giugno, p. 537.

ZATTONI (T.). — I rotabili elettrici policorrente e il loro impiego sulle linee delle Ferrovie Italiane dello Stato. (4 000 parole & fig.)

1958 621 .33 (45)

Ingegneria Ferroviaria, giugno, p. 544.

PICIOCCHI (A.). — Un anno di esercizio della Messina-Palermo con trazione elettrica. (8 000 parole, tavole & fig.)

1958 621 .33 (45)

Ingegneria Ferroviaria, giugno, p. 559.

SANTE BUONI. — I convogli bicornente delle F.S. (7 000 parole & fig.)

1958 656 (43)

Ingegneria Ferroviaria, giugno, p. 586.

SCHULTE-MEERMANN (W.). — Criteri fondamentali della politica dei trasporti della Germania Occidentale. (3 000 parole.)

1958 385 (4)

Ingegneria Ferroviaria, giugno, p. 591.

BELLINGERI (G.). — Alcuni indice statistici sulla produttività delle reti ferroviarie europee nel periodo 1950-1956. (2 000 parole & fig.)

Rivista di Ingegneria. (Milano.)

- 1958 536
Rivista di Ingegneria, giugno, p. 633.
PARTEL (G.). — **Calcolo termodinamico di combustione.** (2 500 parole & tavole.)

Trasporti. (Roma.)

- 1958 385 .1
Trasporti, maggio, p. 235.
SAVOJA (A.). — È possibile risanare il **bilancio ferroviario?** Occorre conoscere meglio i costi dei trasporti. (3 000 parole.)
1958 625 .285 (45)
Trasporti, maggio, p. 246.
PERTICAROLI (F.). — **Automotrici Diesel elettriche** per le Ferrovie secondarie della Sardegna. (2 000 parole & fig.)

Trasporti Pubblici. (Roma.)

- 1958 656 (45)
Trasporti Pubblici, aprile, p. 479.
FONTANELLA (G.). — **Recenti studi economici italiani in materia di trasporti.** (3 000 parole & fig.)
1958 625 .285 (45)
Trasporti Pubblici, aprile, p. 517.
DARD (M.). — **Gli autotreni Fiat serie 101-109.** (1 000 parole & fig.)
1958 625 .28 (494)
Trasporti Pubblici, maggio, p. 683.
Il programma decennale di costruzione delle Ferrovie Federali Svizzere per il materiale rotabile. (5 000 parole & fig.)

In Netherlands.

De Ingenieur. (Den Haag.)

- 1958 691
De Ingenieur, n° 25, 20 juni, p. B.119 en B.120 ; n° 27, 4 juli, p. B.135.
De ontwikkeling van de Betontechniek. I. Inleiding, door A.M. HAAS; II. Prefabricage, door M. GOUT. (3 000 woorden & fig.) ; III. Voorgespannen beton, door A.S.G. BRUGGELING. (3 000 woorden & fig.)
1958 62 (01)
De Ingenieur, n° 31, 1 augustus, p. O.103.
DE PATER (A.D.). — Synopsis : Eigenwaarde-vraagstukken in de mechanica. III. Knikvraagstukken. (15 000 woorden & fig.)

Spoor- en Tramwegen. (Den Haag.)

- 1958 725 .31 (492)
Spoor- en Tramwegen, n° 13, 19 juni, p. 206.
« Druppel aan het einde van de lijn. » Het nieuwe station van Den Helder. (750 woorden & fig.)

1958

621 .132 .8 (73)

- Spoor- en Tramwegen, n° 13, 19 juni, p. 207; n° 14, 3 juli, p. 219.
VAN OMME (N.). — **U.P. Gasturbinelocomotieven.** III en IV. Bedrijfsmoeilijkheden met de 4 500 PK locomotieven. (2 500 woorden & fig.)

1958

625 .113

- Spoor- en Tramwegen, n° 14, 3 juli, p. 215.
BAL (J.F.). — **De methode « Matisa » voor de correctie van bogen.** (2 000 woorden & fig.)

1958

385 (06 .4 (493)

- Spoor- en Tramwegen, n° 14, 3 juli, p. 224.
JACOPS (A.). — **De spoorwegen op de wereldtentoonstelling Brussel 1958.** Nationale deelnemingen : België. (1 000 woorden & fig.)

1958

656

- Spoor- en Tramwegen, n° 15, 17 juli, p. 232.
Scheepvaart, spoorwegen, luchtvaart en wegvervoer op elfde **beroepsvervoercongres.** (3 500 woorden.)

1958

656 .2

- Spoor- en Tramwegen, n° 16, 31 juli, p. 247.
HOOFTMAN (J.C.). — **Doelmatiger werken III. — De kunst van rationeel leidinggeven.** (4 000 woorden.)

1958

656 .2 (73)

- Spoor- en Tramwegen, n° 16, 31 juli, p. 250.
Een Britse kijk op **Amerikaanse spoorwegtoestanden.** (3 500 woorden.)

1958

385 (06 .4 (493)

- Spoor- en Tramwegen, n° 16, 31 juli, p. 254.
JACOPS (A.). — **De spoorwegen op de wereldtentoonstelling Brussel 1958.** (1 400 woorden.)

In Portuguese.

Gazeta dos Caminhos de Ferro. (Lisboa.)

- 1958 385 (09 .3 (469)
Gazeta dos Caminhos de Ferro, n° 1693, 1 de Julho, p. 315; n° 1694, 16 de Julho, p. 327.
DE QUADROS ABRAGÃO (F.). — **No Centenario dos Caminhos de Ferro em Portugal.** Algumas notas sobre a sua história. (6 000 palavras.)

1958

621 .33 (469)

- Gazeta dos Caminhos de Ferro, n° 1694, 16 de Julho, p. 335.
Inauguração do troço electrificado da linha entre Lisboa e Entroncamento. (1 500 palavras & fig.)

Técnica. (Lisboa.)

- 1958 691
Técnica, n° 281, abril, p. 491.
DE SOUSA COUTINHO (A.). — **Pozolanas, betões com pozolanas e cimentos pozolanicos.** (Continuação.) (10 000 palavras, fig. & quadros.)